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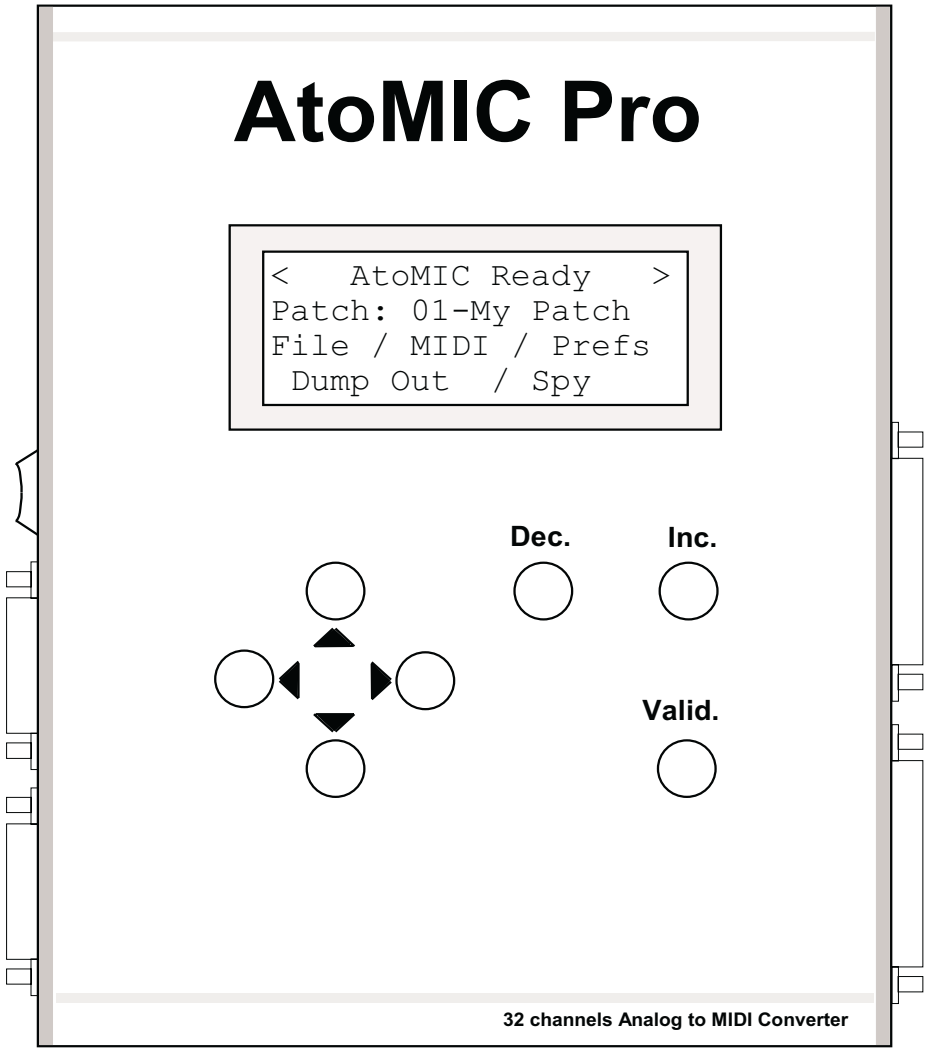
AtoMIC Pro

SENSORS / MIDI INTERFACE

User's Manual



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This user manual was written by Emmanuel Fléty and Bruno Bossis, and translated by Emily Morin. It was kindly proofread by Marc Battier, head of documentation.

The Analog to MIDI interface ***AtoMIC Pro*** was designed and developed by Emmanuel Fléty.

Third edition, June 2002. Version 2 of the documentation.

This documentation corresponds to version 2 of the ***AtoMIC Pro*** interface, version 2.02 of the internal assembler software and version 2 of the Max patches and objects.

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Safety instructions

⚠ Warning
Before using the device, make sure you have read the following instructions carefully, as well as the instructions for use.
Do not open or modify the device or its mains adapter, except when this manual tells you exactly how to do so.
Do not try to repair the interface or the components inside it, except when this manual recommends it. Please contact IRCAM in case of problems.
Do not use the device or store it in the following conditions : - Extreme temperatures, or exposed to direct sunlight. - Damp areas. - Dusty areas. - Areas prone to strong vibrations.
If you replace the main adapter, make sure its output polarity, voltage and current are correct.
Do not insert any objects or pour any liquid into the device.
Protect the device against violent shocks.
Before using the device in a foreign country, make sure the main adapter provided is compatible with the main supply.
If the device will not be used for a long period, disconnect the adapter from the mains.
Never place heavy objects on the device.
Never touch the device or the adapter with wet hands when it is plugged in.
Before moving the device, make sure the mains adapter and/or any external elements are disconnected from the unit.
Before cleaning the device, make sure the mains adapter is electrical unplugged.
If the device is used somewhere where it is likely to be struck by lightning, unplug it.

Notes

IRCAM may only be held responsible for damage caused to devices connected to the ***AtoMIC Pro*** interface if its use conforms to these instructions.

Table of Contents

About AtoMIC Pro

You have just acquired an ***AtoMIC Pro*** interface. In order to benefit fully from its possibilities, you are invited to read this user manual carefully.

Before using this device, please start by reading the safety instructions and the comments on the use of the device (p. 4 and 8). To make sure you fully master this device, we recommend you read this manual in its entirety.

It is also suggested you keep this manual at hand. when you use the device.

Main characteristics

Analog inputs

This device has 32 analog inputs, allowing the conversion of 32 analog signals into MIDI messages.

Digital inputs

This device has 8 digital inputs They enable a device generating digital signals (i.e. 0 or 5V only) to be exported into the world of MIDI.

Digital outputs

Eight digital outputs can be controlled by MIDI messages entering the interface. Enabling (switching to 5V) or disabling (switching to 0V) these outputs allows the separate control of eight devices by digital TTL level signals.

MIDI outputs

The device has four MIDI outputs, allowing an independent control of four MIDI devices.

AtoMIC Pro is an analog to MIDI interface. It converts analog voltages to MIDI messages. The role of such an interface is to convert electrical signals which are representative of a physical phenomenon or dimension (mechanical pressure, temperature, distance between two points) into musical information by using the MIDI standard. Thus, the measurement of a physical dimension can be used to generate music, or to act on some sound parameters.

A single analog signal can generate multiple identical MIDI messages on different MIDI outputs (MIDI routing facilities).

MIDI input

A MIDI input enables the interface to receive MIDI messages from an external system. These messages are destined to change certain configuration parameters of the analog channels and to control the digital outputs.

Liquid Crystal Display (LCD) and keypad

The liquid crystal display and the keypad allow the user to change the configuration of the device by using menus. Changing a parameter has an immediate effect on the operation of the device. The display also allows the user to check in a graphical way the status of signals entering the device.

Non-volatile memory

A non-volatile memory in the device allows the user to save 15 configurations. Each configuration contains the parameters for the 32 analog inputs and for the digital inputs. A name made up of 8 alphanumerical characters can be given to the saved configuration.

Comments on the use of the device

In addition to the *Safety instructions* at the beginning of this document, the following pages explain maintenance procedures for the device when it is to be moved or used.

Power supply

- Do not plug the device into a domestic mains circuit in which are also plugged one or several high power devices capable of generating electromagnetic interference (such as electric engines or dimmer switches).
- The mains adapter may start to heat after long periods of use. This is perfectly normal and is not a sign of malfunction.
- Before connecting ***AtoMIC Pro*** to other devices, switch off the power to *all* devices. This precaution significantly reduces the risk of failure of the device or of those connected to it.

Arrangement and storage

- Using the device next to power amplifiers (or devices with large power transformers) may disrupt its operation. In order to avoid any problems, change the orientation of the device or move it as far away as possible from the source of interference.
- Do not leave the device in direct sunlight, next to sources of heat, in a closed vehicle or in areas prone to extreme temperatures. Excessive heat may warp or discolour the box of the device.

Maintenance

- For regular cleaning of the device, use a soft, fluff-free cloth on the box. Never use water or detergents. Never press on the liquid crystal display.
- Never use hydrocarbons, thinners, alcohol, acids or solvents on the device, or the box will warp or get discoloured.

Repairing the device

- It is important to note that data saved in the device may be lost when the device is sent away to be repaired.
- When the device is being repaired, precautions are taken not to lose any data, but it is impossible to guarantee this, especially when the memory circuit is replaced.

Additional precautions

- It is important to get the data back into memory once it has been lost due to repair. It is recommended that this data be backed up as often as possible, using a MIDI device or a computer with a MIDI interface (see “Section 3 - Connections using MIDI” on page 67).
- It is recommended you be careful when manipulating buttons or connectors on the device. Brusque manipulation of the device may lead to failure or malfunction.
- Do not touch, hit or apply strong pressures to the liquid crystal display of the device.
- Connecting / disconnecting cables must be done holding the connector itself, and not the cable it is joined to. Never pull or push on the cable: that way, you will avoid breaking cables and creating short-circuits.
- When carrying the device, it is recommended, if at all possible, to place it in its box, along with its instruction manual.

Layout of the user manual

This manual details how the analog / MIDI interface works, what the different parameters are for, and how to set them. It is made up of four sections.

Section 1: Introduction

This section details the basic operations which are available on the analog to MIDI interface.

Section 2: Interface configuration guide

This section details what each parameter in the different configuration menus does.

Section 3: Connections using MIDI

This section details how to connect the interface to other MIDI devices.

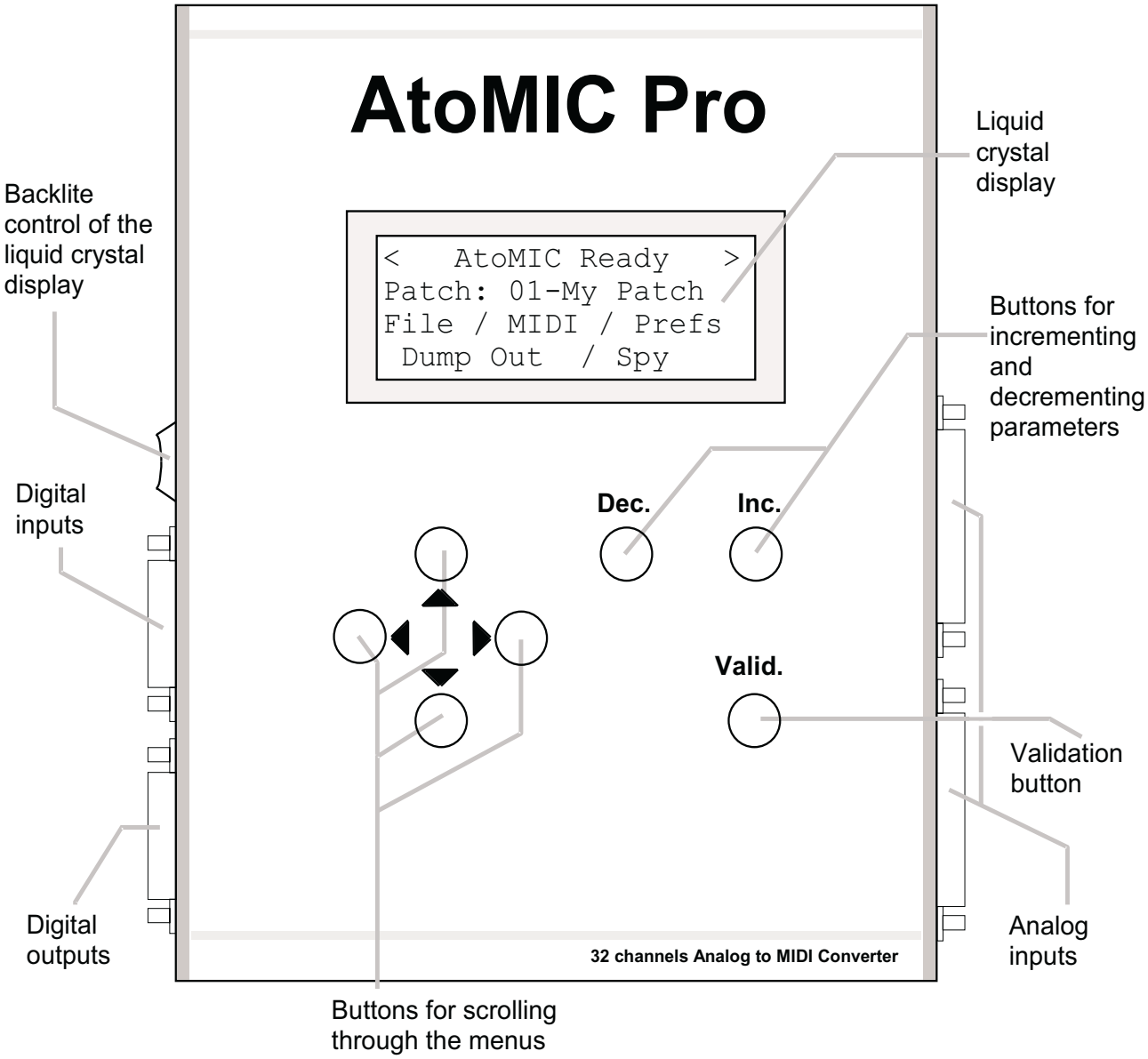
Section 4: Appendices

- MIDI compatibility chart.
- Design specifications of the device.
- Dump using System Exclusive messages.
- Max objects:
  - -Installation
  - -Configuration patch
  - -Dynamic control objects
- In case of problems...
- Replacing the fuse and the mains adapter.
- Restoring the factory settings.
- Powering with batteries.
- Amplifying analog voltages.
- Design examples:
  - -Running lights controlled by MIDI
  - -Using a Force Sensing Resistor (FSR)
  - -MIDI “mixing desk”
  - -Using piezoelectric sensors
- List of MIDI controllers.

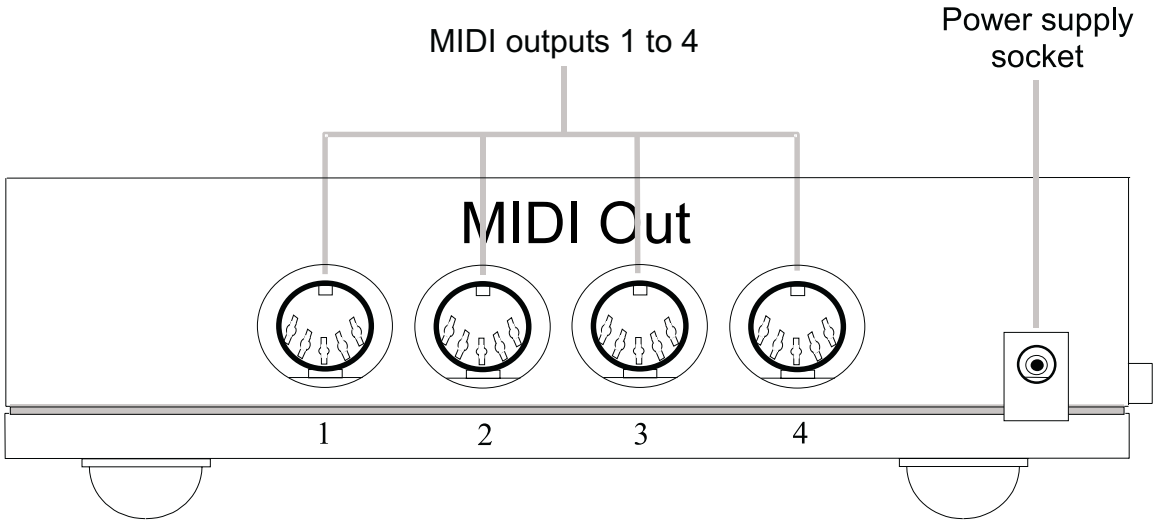
Index of terms used

User interface and connectors

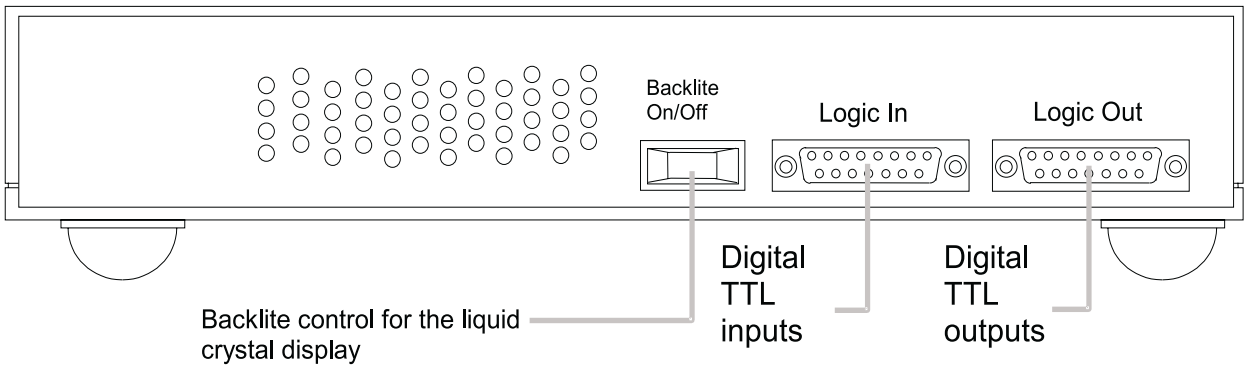
Top view



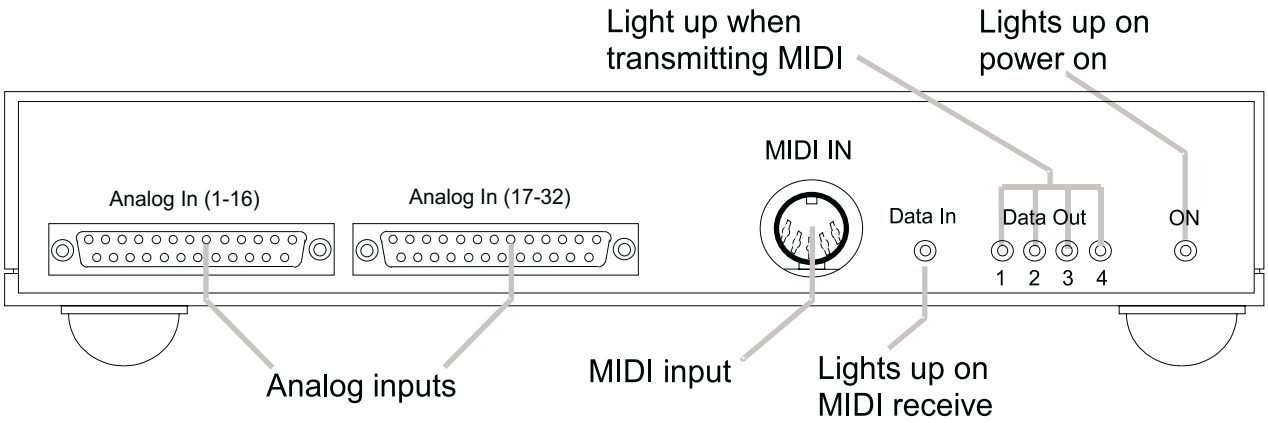
Back view



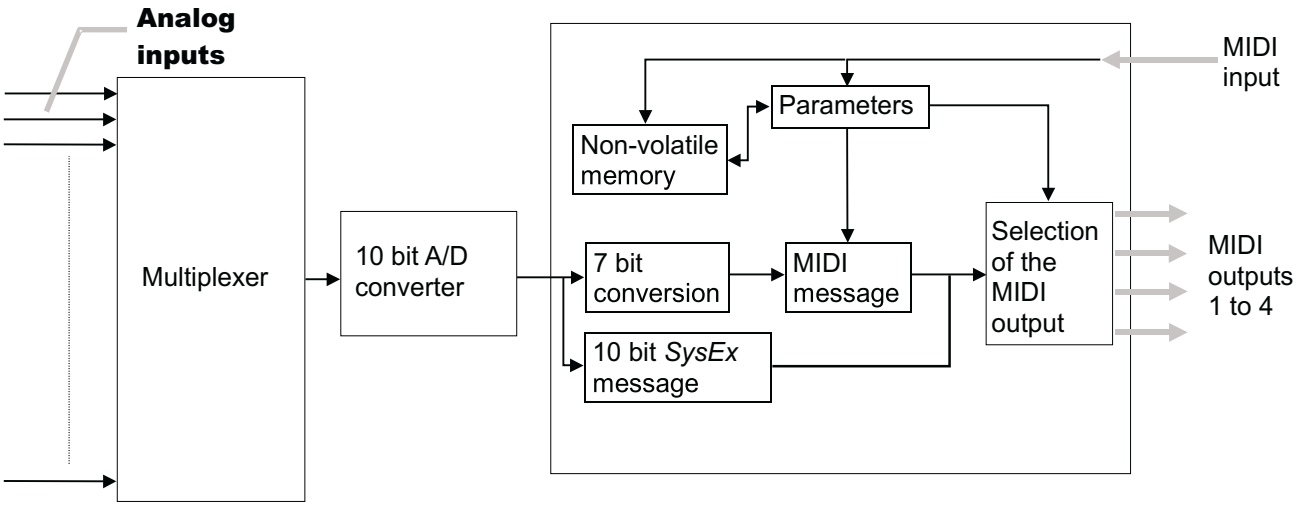
Left view



Right view



Internal architecture of *AtoMIC Pro*



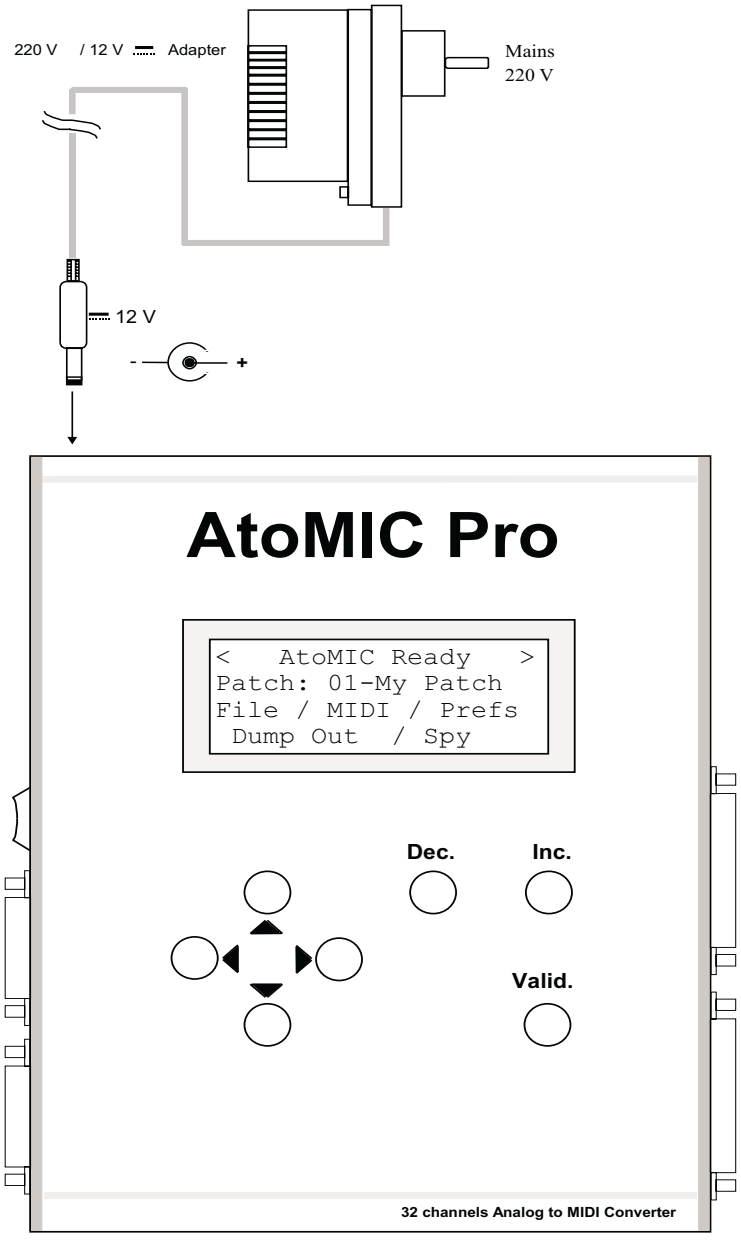
The multiplexer sequentially connects the different analog inputs to the 10 bit Analog to Digital Converter. The digital value obtained is converted into a 7 bit value to conform to the MIDI standard. The user may however keep the 10 bit original resolution by converting the digital value into an exclusive MIDI message (*System Exclusive*), through a pitch bend message or through a combination of two *Control Change* messages.

Certain control parameters allow the configuration of different MIDI messages which export the digital value to the world of MIDI. The message is then routed to a selection of MIDI outputs among the four ports available. A host system may communicate with ***AtoMIC Pro*** via the MIDI input to configure the device before use and to make certain parameters change dynamically with time.

Section 1 - Introduction

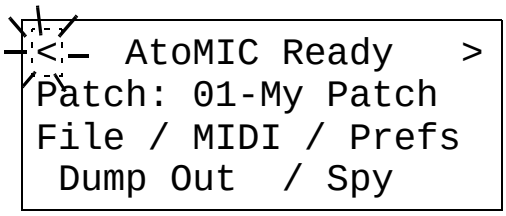
Powering up

Take ***AtoMIC Pro*** and its mains adapter. Connect the output of the mains adapter to the device, then plug the adapter into a domestic mains socket.



Welcome screen / Scrolling through the menus

When the device is powered up, it initialises itself and then displays the following information :



A flashing cursor should appear in the top left-hand corner of the screen at the same time as the display shown above. This display, or menu, is the welcome screen of the user interface and indicates that the device was correctly initialised. In this document, the flashing cursor will be represented by underlining the represented area, and putting it in bold font.

The menus which are displayed on the liquid crystal display (LCD) are made up of different fields. Pressing the arrow keys of the keyboard (< > ∧ ∨), moves the flashing cursor towards the next field, in the direction corresponding to that of the pressed key.

The arrows shown in the top left and right-hand corners provide access to different configuration menus. There are 8 menus or display screens, which are connected to each other along a virtual horizontal axis, except for the sub-menus accessible from the welcome screen (*File*, *MIDI*, *Prefs*, *Dump Out* and *Spy*). You gain access to these menus by positioning the flashing cursor on the menu of your choice, and then pressing the Valid key.

The display of the different menus and screens along the horizontal axis is cyclic.

On the second line of the welcome screen, the number of the current configuration patch appears (numbered from 1 to 15), along with its name made up of 8 alphanumerical characters. To change the name of the configuration patch, refer to *"Changing the name of a patch, the contrast of the Liquid Crystal Display, and the reference voltage of the Analog to Digital Converter" on page 60*.

Modifying a parameter

From the welcome menu go to configuration menu number 1 (labelled #1 on the first line of the LCD) using the right arrow key [→]. The liquid crystal display then shows the following menu:

```
<  #1       Ch:1   >
Stat:OFF    Var: +
Msg:N-ON Af Val:1
MIDI Ch:1   Out:xxxO
```

To modify a parameter, use the arrow keys to position the flashing cursor on the field of the chosen parameter. Change the value using the increment and decrement keys (Inc. and Dec.) situated to the right of the arrow keys.

For example, place the cursor on the Stat field (status of an analog input, active or inactive). Pressing on the Inc. or Dec. keys will change the value of the field (ON or OFF).

```
<  #1       Ch:1   >
Stat:OFF    Var: +
Msg:N-ON Af Val:1
MIDI Ch:1   Out:xxxO
```

[Inc.]

```
<  #1       Ch:1   >
Stat:ON     Var: +
Msg:N-ON Af Val:1
MIDI Ch:1   Out:xxxO
```

Since certain parameters have a high number of values (128 for MIDI parameters), it is possible to increment or decrement quickly the value of a parameter by keeping the Inc. or Dec. key pressed for at least a second. The values change rapidly then, until the key is released.

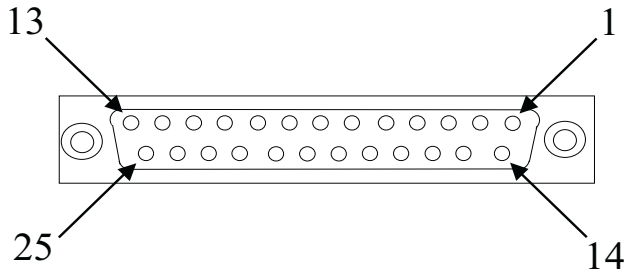
Analog inputs

As its name indicates, the analog to MIDI interface converts one or several analog electrical signals into MIDI messages. In the case of ***AtoMIC Pro***, these signals **must be voltages larger than or equal to zero and smaller than or equal to 5 volts**. Negative voltages are to be avoided as they can damage the device, just as voltages over 5V can.

The purpose of ***AtoMIC Pro*** is to convert electrical signals which are representative of a physical phenomenon or dimension (mechanical pressure, temperature, distance between two points) into musical information using the MIDI standard. Thus, the measurement of a physical dimension can be used to generate music or to act upon some parameters of sound (master volume, panpot, effects volume).

The device is equipped with two 25 pin Sub-D connectors located on the right-hand side of the box. These connectors are used to input the analog signals into the device so it can convert them into MIDI. The value of the impedance of the analog inputs is 1MΩ.

Not only can the analog signals come from complex measuring devices, but they can also come from ordinary sensors, as long as their dynamic range is compatible with ***AtoMIC Pro***.

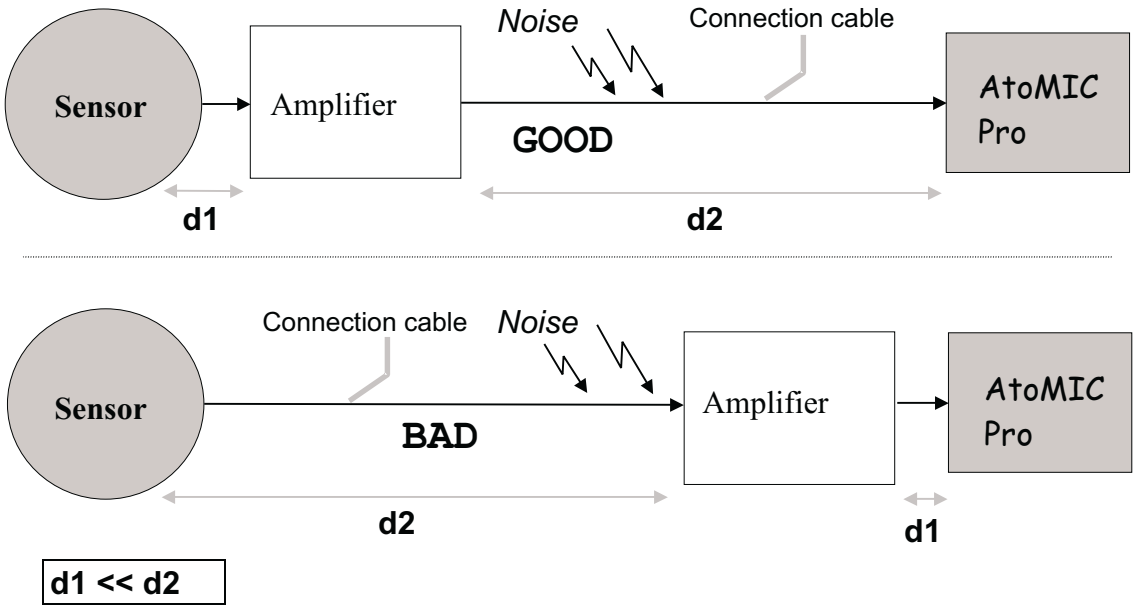


Pin n°	*Function*
1-16	Analog inputs 1 to 16 (17 to 32 on the second connector)
17	Not connected
18-21	Ground
22-23	+5V
24	+12V
25	-12V

The device first performs an analog to digital conversion of the voltages on the analog inputs. The digital value thus obtained is used as a parameter or a trigger of a MIDI event which was chosen beforehand, and configured in the internal memory of the interface. The event or MIDI message is sent to a compatible device through the MIDI outputs on the back of the device via a compatible cable (not supplied).

It is important to note that the analog to MIDI interface is rarely used on its own. Not only does it use the devices that it controls or with which it exchanges information, but also, if necessary, it will work with electronic devices which normalise signal levels. In the case of the measurement of physical dimensions, the sensors used do not always deliver an output voltage which is sufficient to ensure compatibility with the interface. It is therefore necessary to amplify the signals before feeding them into ***AtoMIC Pro***. The need for amplification comes from the fact that low level signals are particularly vulnerable to noise. This noise is usually generated when the signal travels through a conducting cable. If the noise is of a level similar to the maximum amplitude of the signal, the latter will be drowned in noise and will remain unusable.

Amplification of low level signals is therefore done as near to the signal source as possible, before the noise can affect it. The signal obtained has a low noise level compared to the useful signal level.



A certain number of sensors, however, do deliver a so-called preconditioned signal, i.e., preamplified and shaped.

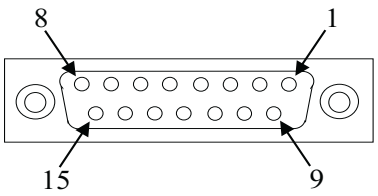
Amplification is also necessary when the signals from sensors or other devices are too different in sensitivity or in level. The signals must then be fed through an amplifying device with adjustable gain for each signal to be fed to the analog / MIDI interface. Refer to “Section 4 - Appendices” on page 73 for more

information on the conditioning and amplification of electrical signals. Also consult the paragraphs entitled “Changing the reference voltage of the analog to digital converter / ADC Vref field” on page 61 in section 2.

Digital outputs

The device is equipped with two 15 pin Sub-D connectors located on the left-hand side of the box. The one on the right outputs 8 on or off signals (also called digital TTL level signals). Each one of these outputs gives out either 0 or 5 volts. These signals may be used to control devices which work in a binary fashion, i.e. with 2 states (test light on or off for example).

Each output can deliver a maximum current of 10 mA. If the device is used to control one or more outputs needing a higher current or voltage, it will be necessary to build suitable electronic power amplifying device.



Pin n°	Function
1-8	Digital outputs 1 to 8
9-13	Ground
14-15	+5V

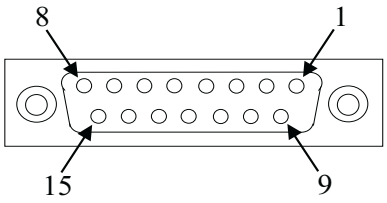
The state of these outputs is controlled by MIDI, using *System Exclusive* messages on the MIDI IN of the device. Read section 4 (Appendices), the paragraphs entitled *Running lights controlled* by MIDI, and *Dynamic control of **AtoMIC Pro** using System Exclusive messages* for more details on control operations on the digital outputs.

→ **WARNING :**

When ***AtoMIC Pro*** is powered up, the digital outputs briefly take on the value 1 (+5V). Please make sure the devices connected to the digital outputs do not risk being damaged or injuring anyone near the installation (high power electric motors, pneumatic equipment, etc.).

Digital inputs

The second 15 sub-D connector situated on the left-hand side of the box, to the left of the connector for the digital outputs, enables the analog / MIDI interface to receive 8 digital TTL level signals. These inputs are designed to receive signals of 0 or 5 V generated by devices working in binary (pedal which is either fully up or fully down for example).

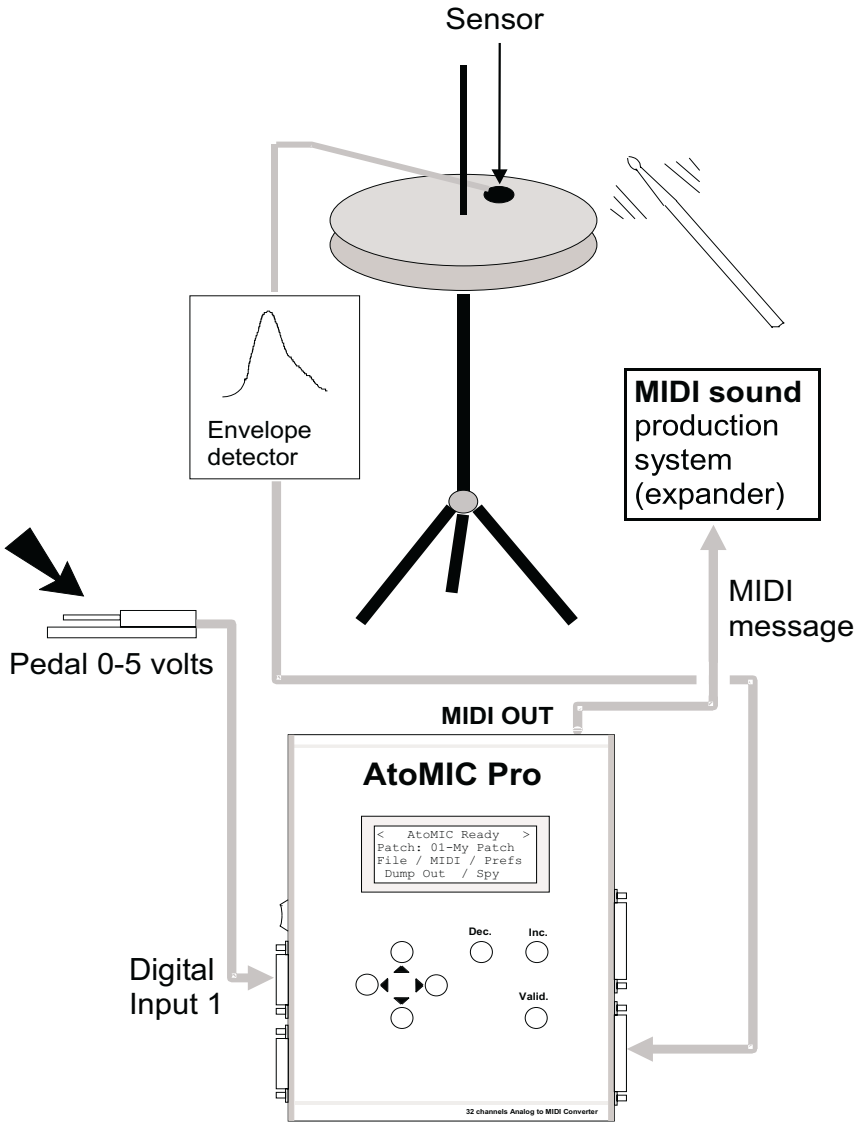


Pin n°	*Function*
1-8	Digital inputs 1 to 8
9-13	Ground
14-15	+5V

These inputs have two functions. The first, when the eight inputs are used simultaneously, is to convert the information from 8 bit binary information into MIDI. This method is very useful when a measuring device outputs a digital result over 8 bits. This result may be sent directly to ***AtoMIC Pro*** via the digital inputs and converted into a MIDI message.

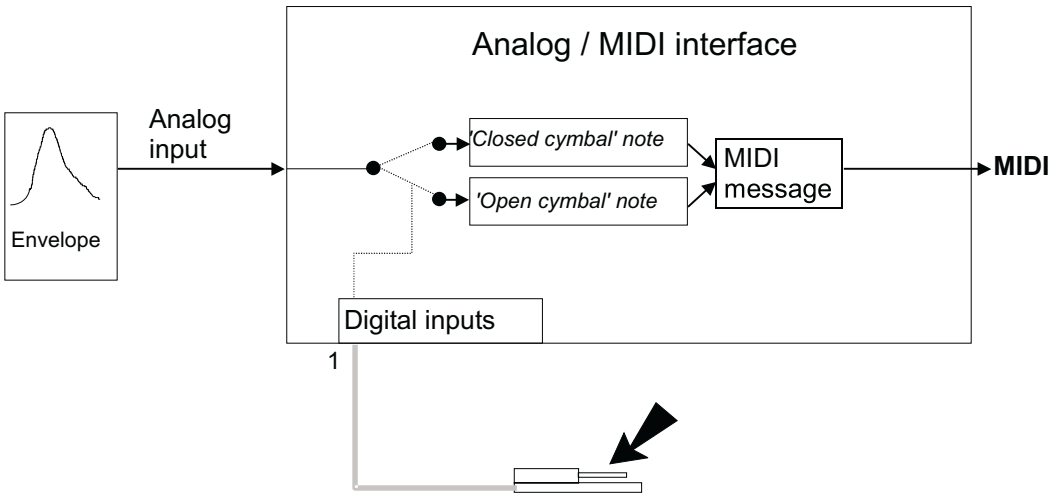
When the TTL digital inputs are used separately (bit by bit), the state of a particular digital input may act dynamically on a parameter of the MIDI message associated with an analog input. When the digital input under consideration is at logic state 0 (i.e. zero volt), the parameter ‘normal’ of the MIDI message is used. When the input is at logic 1 (i.e. five volts), another parameter, configured by the user, is used for the MIDI message.

Example: MIDI Charleston cymbal



This illustration shows how an electronic Charleston cymbal works. The point of this setup is to produce two different tones depending on the position of the pedal (open or closed cymbal).

A sensor gives a signal which measures the amplitude of the resonance of the cymbal. The envelope of this signal is worked out, then transmitted to the interface. This configuration then generates a MIDI note with a velocity proportional to the impact of the stick on the cymbal. The pedal which is connected to the digital input tells the analog / MIDI interface which tone (MIDI note number) to send the sound producing system, in accordance with the MIDI standard of percussion sound banks.



The selection of one or the other of the notes is performed as a function of the state of the chosen digital input. The number of the input is also configurable out of the eight available inputs. Refer to the paragraphs entitled “Second menu for configuring the analog inputs (menu #2)” on page 47 and “Fifth menu for configuring the digital inputs (menu #5)” on page 56 in section 2 for more details on this type of operation.

Exporting supply voltages

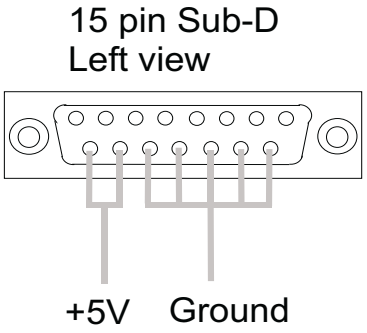
In order to make powering the active measuring devices (i.e. those devices requiring a power supply) easier, ***AtoMIC Pro*** exports its own supply to an outlet. This supply is regulated and protected inside the device and gives the following DC voltages:

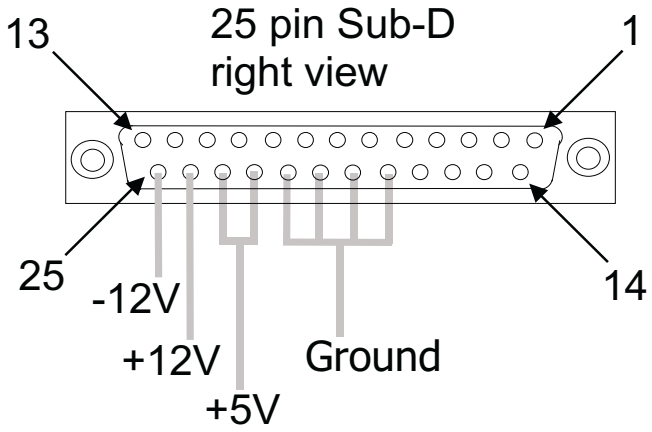
+ 5 volts for a maximum current of 300 mA.

+ 12 volts for a maximum current of 80 mA.

- 12 volts for a maximum current of 80 mA.

These voltages are available on the Sub-D connectors on the left and right-hand sides of the device.

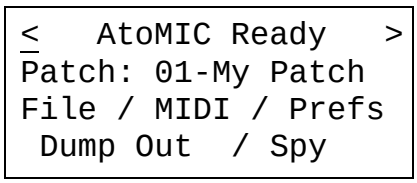




Monitoring signals on the Liquid Crystal Display (LCD)

Two display screens enable the user to see the signals entering ***AtoMIC Pro***. These screens are used to make sure the sensors or measuring devices are functioning properly. They also allow the user to check that the different signals are properly scaled.

To access these display screens, move the flashing cursor towards the left arrow of the welcome screen.



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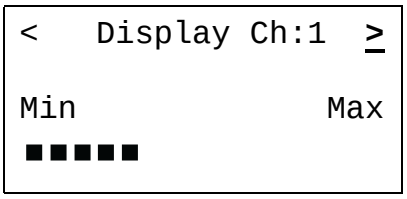
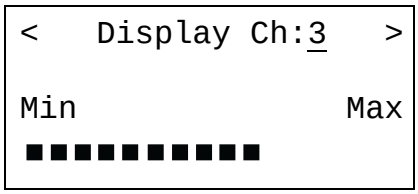


This first display screen shows one analog input out of thirty two. The level of the signal is shown using a horizontal VU-meter on the fourth line of the liquid crystal display. The VU-meter is made up of 20 spaces. When these twenty spaces are filled in black, the level of the signal is at its maximum.

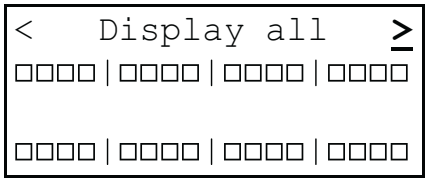
To change the current channel number, move the flashing cursor onto the Ch (Channel, analog channel number) field. Modify the channel number using the increment and decrement keys (Inc. and Dec.).

[*2 x Inc.*]

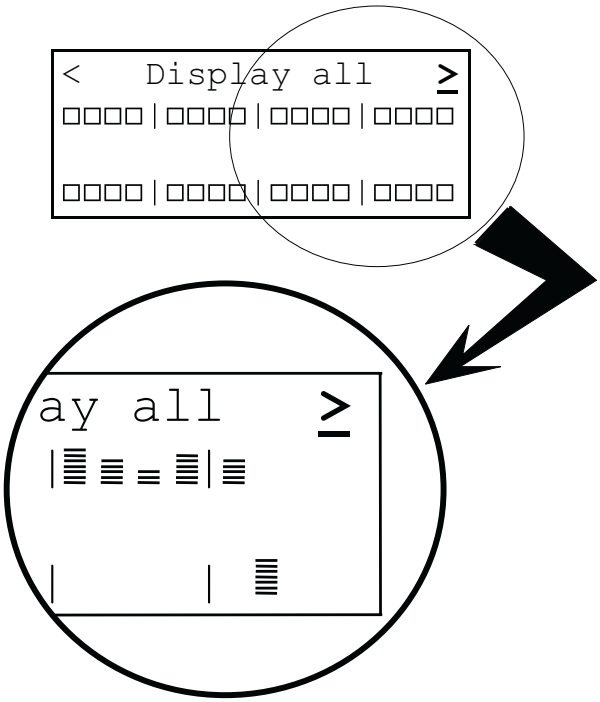


To simultaneously see all the active signals entering the device, move the flashing cursor to the left to another display screen.

[<]



Each little square represents a vertical mini-VU-meter with seven segments (see figure below). In spite of the low resolution of such a VU-meter, this screen enables the user to see the variations in all the active signals simultaneously, inputs 1 to 16 and 17 to 32.

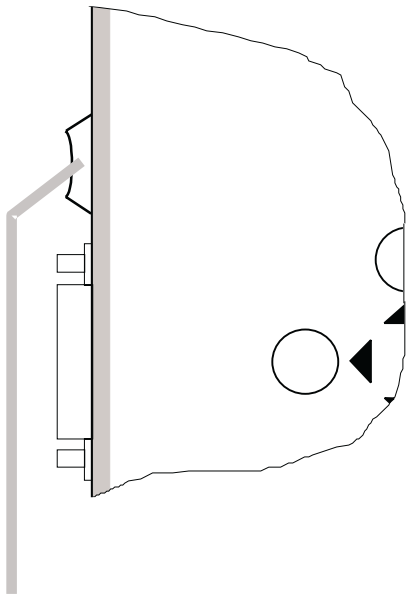


NOTE :

Due to the screen refresh rate, displaying all the signals simultaneously degrades the data acquisition performance of ***AtoMIC Pro***. It is recommended that you exit these display modes during normal operation of the device.

Controlling the backlite of the liquid crystal display

The Liquid Crystal Display uses a “backlite”. This enables the user to see what is displayed when the device is used in poor lighting conditions. A toggle-switch situated on the left side of the box switches the backlite on and off.



Toggle-switch used to light the liquid crystal display

Section 2 - Interface configuration guide

This section explains how to modify the configuration of ***AtoMIC Pro***, as well as the role of each configuration parameter. This section also explains the methods for saving and loading different configurations inside or from the non-volatile memory in the device.

Before modifying the configuration of the device

Before trying to configure ***AtoMIC Pro***, make sure you have read the following information.

Memory banks - Patches

To enable the device to be used in many contexts, it is equipped with a non-volatile memory capable of saving different parameter configurations. All the parameter values are grouped into a *patch* where the configuration for all 32 analog inputs and the digital inputs is stored. Twenty configuration *patches* can be saved in the device memory. A name made up of eight alphanumerical characters can be associated with each patch.

The configuration in current use is stored in volatile memory (RAM).

Before switching the device off you should, if need be, save the current configuration. The modifications stored in RAM are not automatically saved to non-volatile memory.

When powering up, the patch which was last active is loaded automatically.

Connection to sound producing equipment

If the device is plugged into any sound producing equipment when you modify the configuration of the device, it is advised that you turn the sound level down. Improper manipulation of ***AtoMIC Pro*** along with dangerous handling of the sensors or the measuring equipment may lead to hazardous sound levels for people nearby, as well as for the equipment itself, especially the loudspeakers.

Main menu for configuring the analog inputs (menu #1)

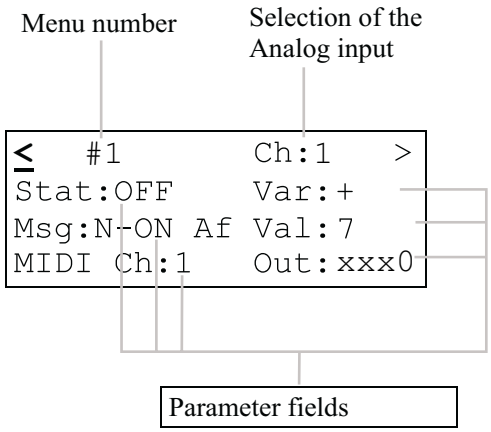
The main configuration menu is accessed from the welcome screen by moving the flashing cursor towards the right arrow (menu #1).

```
<   AtoMIC Ready   >
Patch: 01-My Patch
File / MIDI / Prefs
 Dump Out  / Spy
```

[>]

```
<  #1        Ch:1    >
Stat:OFF     Var: +
Msg:N-ON Af  Val:1
MIDI Ch:1    Out:xxxO
```

On this screen are the name of the patch, the selected field of the analog input for which the configuration is to be modified, and six parameter configuration fields.



Before making any modifications to the displayed configuration, make sure it corresponds to the analog input configuration you want to alter.

Analog input status / `Stat` field

`Stat: ON / OFF`

The `Stat` field indicates whether the signal on an analog input should be converted into a MIDI message. This field may be set to one of two values *`ON`* or *`OFF`*. If the field is set to *`OFF`*, the input is said to be *inactive* and no MIDI message relating to that input will be generated, even if a signal does physically enter the device. If the field is switched back to `ON`, the input is *active* and its associated MIDI message will be sent each time the signal connected to that input varies in level.

→ **NOTE :**

The smaller the number of active inputs, the higher the acquisition frequency of the active inputs. It is possible to change the value of this field dynamically, from the user interface of the device, but also from a host system which is compatible with MIDI. To do this, the host must send *System Exclusive* MIDI codes onto the MIDI IN connector of the analog / MIDI interface. Refer to “Section 3 - Connections using MIDI” on page 67 and “Section 4 - Appendices” on page 73 for further details on this type of operation.

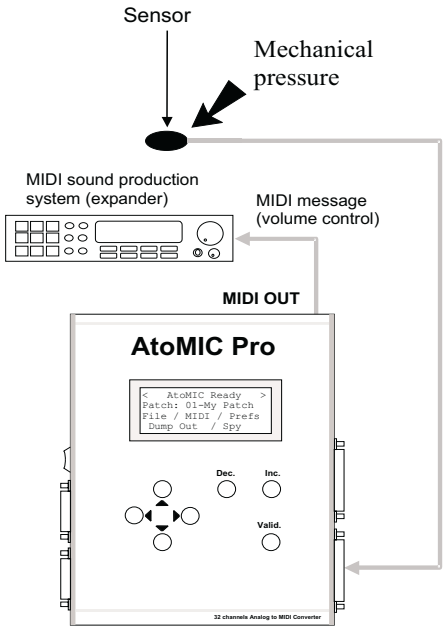
Direction of signal variation / `Var` field

`Var: + / -`

With this field the user may chose how the analog / MIDI interface interprets signal variations on the analog inputs. This field may be set to one of two values + or – (positive or negative variations).

If this field is set to +, the MIDI message value follows the same variations as the signal on the analog input. Conversely, if the field is set to -, the MIDI message value will follow the opposite of the analog signal variations.

Example : volume control using a mechanical pressure sensor



→ Hypothesis: the sensor gives a voltage which is proportional to the mechanical pressure applied onto its surface.

If the `Var` field is set to +, the analog / MIDI interface will send a volume control message proportional to the mechanical pressure applied to the sensor. To make it react in the opposite way, change the field value to -.

Choice of MIDI message / `Msg` field

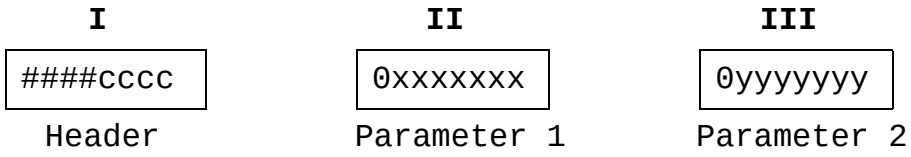
This is one of the most important configuration parameters, since it determines which type of MIDI message the device is going to send in response to variations in a particular analog input.

AtoMIC Pro is capable of generating 10 different messages. These messages are based on the 7 MIDI channel messages and the MIDI System Exclusive messages.

The MIDI standard specifies 7 commands called channel messages:

- Note on *(Note-on)*
- Note off *(Note-off)*
- Polyphonic pressure *(Polyphonic aftertouch)*
- Control number change *(Control change)*
- Program change *(Program change)*
- Channel pressure (*Channel aftertouch*)
- Variation in pitch (*Pitch bend*)

These messages are usually made up of three groups one octet long, as shown in the following illustration :



####:	Message code (4 bits)
cccc:	MIDI channel number to which the message is applied (4 bits)
xxxxxxx:	Value of the 1st message parameter (7 bits)
yyyyyyy:	Value of the 2nd message parameter (7 bits)

Message	Parameter 1	Parameter 2
Note on (Note on)	note number	note on velocity
Note off (Note off)	note number	note off velocity
Polyphonic pressure (Polyphonic aftertouch)	note number	pressure during note on
Control number change (Control change)	controller number	controller value
Program change (Program change)	program number	/
Channel pressure (Channel aftertouch)	pressure	/
Variation of pitch (Pitch bend)	strong weighting of pitch (MSB*)	weak weighting of pitch (LSB**)

If the message uses two parameters (not in the case of a change in pitch), the first parameter is specified in the `Val` field (see further down) whereas the second follows the variations of the signal on the analog input which is associated with the MIDI message.

Example : controller value change message

For a message of this type (*Control change*), the controller number is fixed, when the converted analog signal controls the value of the controller.

* Most Significant Byte.

** Least Significant Byte.

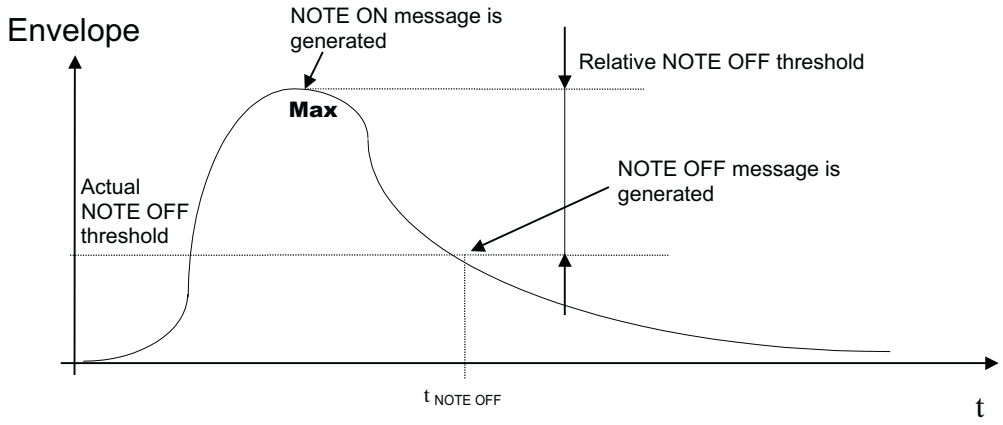
List of MIDI messages generated by *AtoMIC Pro*

Message	*Notation used on the Liquid Crystal Display*
Note on	N-ON
Note on + polyphonic pressure	N-ON Af
Note on with trigger threshold	N-ON Tr
Controller value change	C-Chg
Controller value change with trigger threshold	C-Chg Tr
Program change with trigger threshold	Prg Chg
Pitch change	P-Bend
Polyphonic pressure	Af-Tch1
Channel pressure	Af-Tch2
10 bit exclusive message	SysEx10

Af : Aftertouch
Tr : Threshold
P-Bend : Pitch bend

- **Note on message / N-ON**

The analog signal must correspond to an envelope changing with time and which has a maximum value. ***AtoMIC Pro*** analyses this envelope and finds the largest peak. Once it has been found, a MIDI *note on* message (*NOTE ON*) is generated. The velocity associated with the note is equal to the maximum of the envelope. The note number contained within the message is adjustable by the user (see "Setting the MIDI note number" on page 45).



As long as the envelope stays above a threshold, named *NOTE OFF threshold*, the note is maintained (no new MIDI message is sent). When the level falls beneath the *NOTE OFF threshold*, a MIDI NOTE OFF message is sent to turn the note off.

The NOTE OFF threshold is relative to the maximum detected envelope level. Once the peak level has been found, ***AtoMIC Pro*** calculates an actual NOTE OFF threshold from the value of the relative threshold:

Actual threshold = Max – relative threshold

The relative NOTE OFF threshold is adjustable by the user in another configuration menu (see *"Setting the NOTE ON and NOTE OFF trigger thresholds" on page 50*). To sustain the note for a long period of time, you just need to give a large value to the relative NOTE OFF threshold. Conversely, to make the note stop shortly after the peak has been detected, you need to set the relative NOTE OFF value quite low.

This type of message is useful in using sensors to simulate[1] MIDI keyboards which are sensitive to velocity.

1. In most MIDI keyboards, the method for determining the intensity of a note is based on the measurement of velocity and not pressure or force.

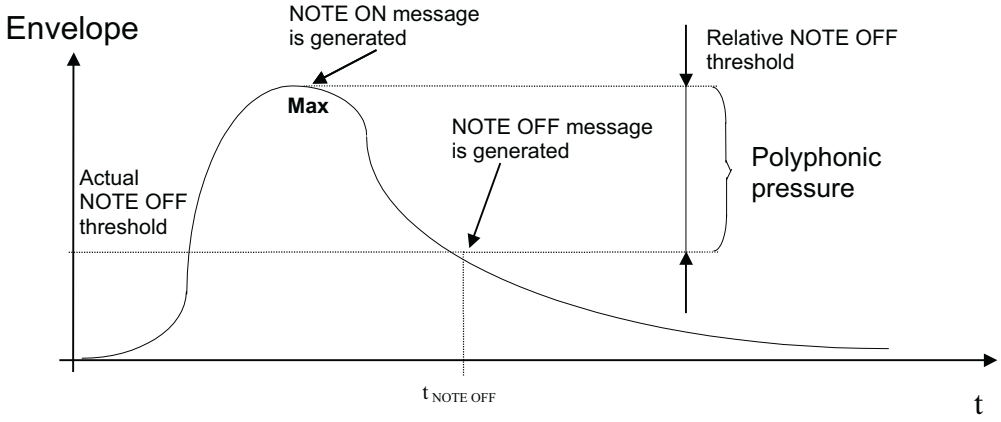
• Note on message with polyphonic aftertouch / N-ON Af

This message works in the same way as the *note on* message, except that a polyphonic pressure message (*polyphonic aftertouch*) is sent as long as the note is on.

The amplitude of the polyphonic pressure is calculated in the following way:

pressure = signal(t) – actual NOTE OFF threshold

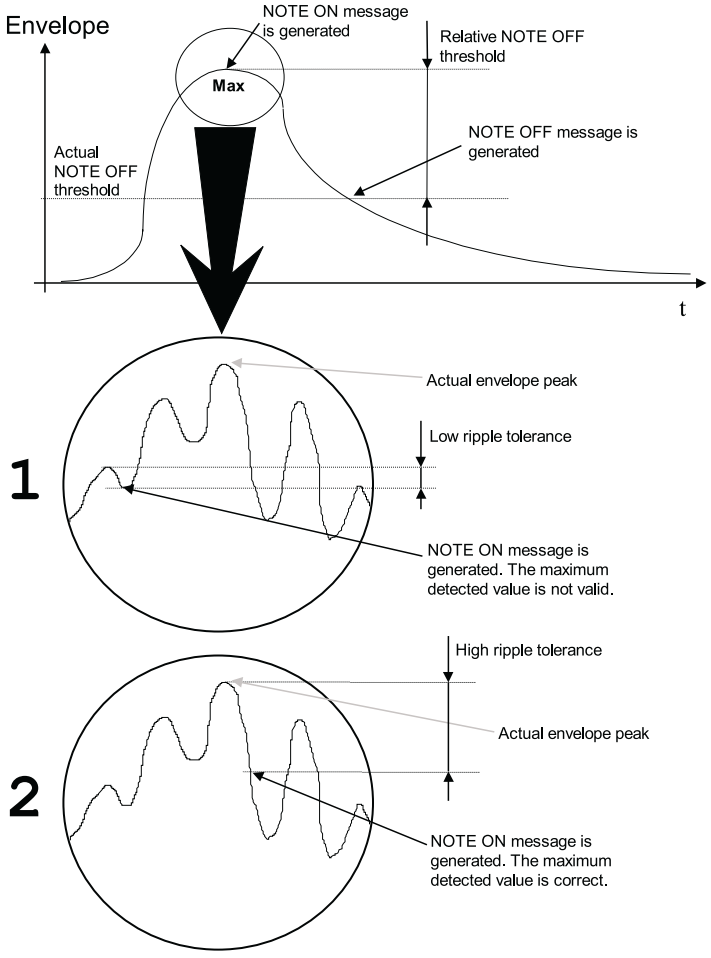
Thus, the bigger the relative NOTE OFF threshold, (actual NOTE OFF threshold is small), the bigger the dynamic range of the polyphonic pressure.



This type of message may be used to simulate the behaviour of MIDI keyboards which are sensitive to velocity and *aftertouch*.

NOTE :

Envelope detection needs a particularly stable envelope which is free from ripples. If ripples do occur, they could be interpreted as envelope peaks, and this could lead to invalid detection. ***AtoMIC Pro*** is however protected against possible ripples by an algorithm. It is possible to specify the tolerance of the algorithm to the ripples in order to obtain envelope peak detection which is robust in all cases. This tolerance to ripples is specified by a parameter field of the secondary configuration menu for the analog inputs (see "Multipurpose parameters n° 2 and 3 / `Prm2` and `Prm3` fields" on page 50).

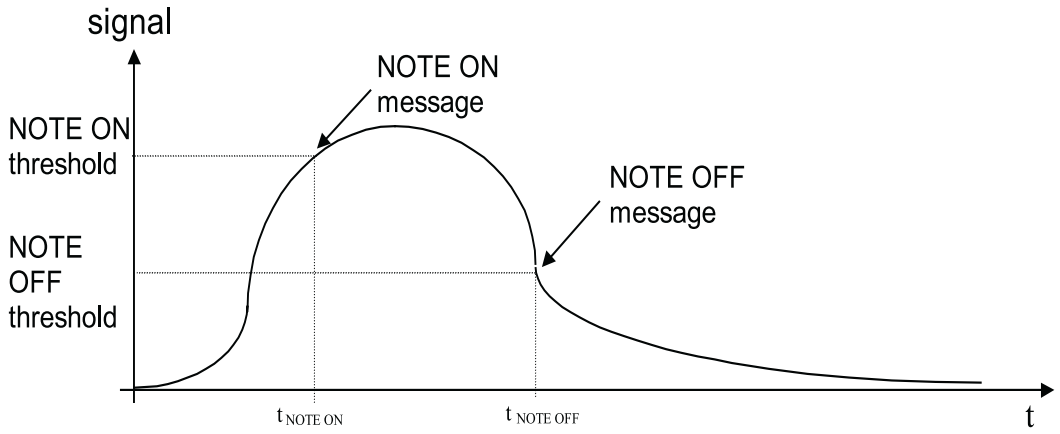


The ripple tolerance of the envelope is relative to a maximum detected level. If the signal is beneath this peak value but stays within the ripple range, the algorithm will allow the possibility that another peak value is present in the envelope, and that it may be its real maximum value. If the signal goes beneath the limit specified by the ripple tolerance, the NOTE ON message will be generated anyway, with a velocity equal to the last maximum value found in the envelope.

If the envelope has a lot of ripples, the ripple tolerance should be set to a high value so as to obtain an efficient detection of the actual envelope peak.

• Note on message with trigger threshold / N-ON Tr

This message allows a MIDI note with fixed velocity to be generated. The switching on and off of the note is controlled by two thresholds : the *NOTE ON threshold* and the *NOTE OFF threshold*. These two thresholds are controlled by the user from another configuration menu (see “Setting the NOTE ON and NOTE OFF trigger thresholds” on page 50).



The specified thresholds are absolute values this time, and the peak value of the envelope is not used either.

This type of message can be used to simulate the behaviour of MIDI keyboards which are not velocity-sensitive. The velocity which MIDI uses has to be set by the user (see “Setting the velocity of note on with trigger threshold messages” on page 49).

• Controller value change / C-Chg

This is the type of message which will likely be most often used for controlling sound parameters. The value of the analog signal acts directly upon the value of a MIDI controller, using a MIDI *controller value change* message (*control change*). The number of the controller can be set by the user (see “Setting the MIDI controller number” on page 45). If 10 bit resolution is selected, this message will actually send two *control change* messages. The controller specified in the *val* field will send the 7 least significant bits whilst the controller specified in the *alt* field (menu #2) will send the 3 most significant bits, on the same MIDI channel.

• Controller value change with trigger threshold / C-Chg Tr

As with the *note on with trigger threshold* message, this message allows a fixed value to be sent to a specific MIDI controller, also using the idea of thresholds. When the signal level reaches the first threshold, the fixed value of the controller is sent by a *controller value change* type MIDI message (*control*

change). When the signal reaches the second threshold, the value of the specified controller is set to zero. The thresholds are controlled by the user (see “Setting the threshold for controller value change messages” on page 50).

The controller value which is generated by the MIDI message is adjustable by the user (see “Setting the controller value of controller value change with trigger threshold messages” on page 49).

• Program change with trigger threshold / Prg-Chg

This message allows an analog signal to trigger a *program change* MIDI message using the idea of thresholds. The program number is fixed when the device is in use, but may be adjusted by the user, along with the trigger threshold levels (see “Setting the MIDI program number” on page 45, and “Setting the program change threshold” on page 50).

This message can be used to simulate MIDI pedals which send program change messages.

• Pitch change / P-Bend

This message allows an analog signal to generate a MIDI message of the *pitch change* type (*pitch bend*). Pitch is usually coded over 14 bits. If the 7 bit resolution is chosen, they will be mapped on the 7 most significant bits of pitch information controlled by the analog signal. However, since ***AtoMIC Pro*** does 10 bit conversions internally, the whole 10 bits can be mapped to take better advantage of the pitch bend message.

This message is used to simulate the pitch changing wheels available on most MIDI keyboards.

• Polyphonic pressure / Af-Tch1

This message allows an analog signal to generate a *polyphonic pressure* type MIDI message (*polyphonic aftertouch*). The number of the note to which the pressure information is applied can be changed by the user (see “Setting the MIDI note number” on page 45).

• Channel pressure / Af-Tch2

This message allows an analog signal to generate a *channel pressure* type MIDI message (*channel aftertouch*). This pressure message affects a whole MIDI channel, regardless of what note is played. The channel number to which the pressure information is applied is selected by the user (see “Setting the MIDI channel number / `MIDI Ch` field” on page 45).

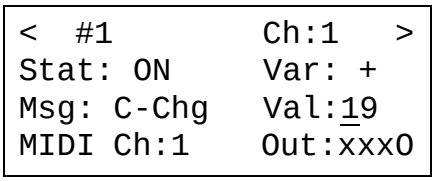
• 10 bit exclusive message / SysEx10

This message allows the transmission of the result of the analog / digital conversion. The digital value is transmitted over 10 bits in a MIDI System Exclusive message. Refer to “SysEx10 System Exclusive message” on page 93 to learn about the structure of this message.

Setting the fixed parameter of a MIDI message / `Val` field

`Val: 0-127`

This field enables the user to set the fixed parameter of a MIDI message associated with an analog input. This parameter value may correspond to a MIDI note number, a MIDI controller number or a MIDI program number, depending on the type of MIDI message which is chosen.



Setting the MIDI note number

Using the *Inc.* and *Dec.* keys, select the MIDI note number you want from the 128 available values (0 to 127).

Setting the MIDI controller number

Using the *Inc.* and *Dec.* keys, select the MIDI controller number you want from the 128 available values (0 to 127). Refer to “Section 4 - Appendices” on page 73 for a list of existing MIDI controllers.

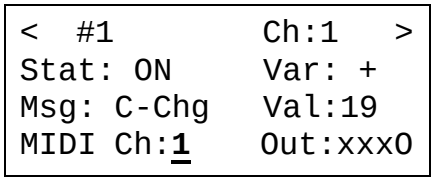
Setting the MIDI program number

Using the *Inc.* and *Dec.* keys, select the programme number you want from the 128 available values (0 to 127).

Setting the MIDI channel number / `MIDI Ch` field

`MIDI Ch: 1-16`

This field enables the user to select a MIDI channel to which the MIDI message will apply (1 to 16).



Selecting a MIDI output / `Out` field

`Out: 1-4`

AtoMIC Pro has 4 independent MIDI outputs situated on the back of the box. This field enables the user to select any combination among the 1 to 4 the MIDI output to which the message is to be sent.

```
<  #1        Ch:1   >
Stat: ON     Var: +
Msg: C-Chg   Val:19
MIDI Ch:1    Out:xOxO
```

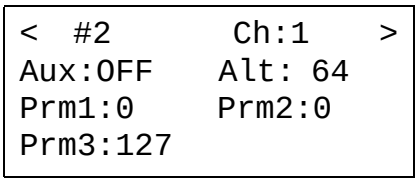
The outputs are represented as they are located on the back of the box (4 to 1 from left to right). A cross 'x' indicates that the output is not selected whilst a 'O' shows an active output. The four MIDI ouputs gives you 16 possibilities for routing the MIDI message for each analog input.

Recapitulative example :

If you want to control the panpot (MIDI controller number 10) of two MIDI sound production system configured on channel 2, using MIDI outputs 1 and 3 and a sensor or a measuring device connected to analog input number four, all you need to do is the following :

```
<  #1        Ch:4   >
Stat: ON     Var: +
Msg: C-Chg   Val:10
MIDI Ch:2    Out:xOxO
```

Second menu for configuring the analog inputs (menu #2)



Setting the digital input number / `Aux` field

`Aux: OFF / 1-8`

This field enables the user to select the digital input number which is to control the fixed parameter of a MIDI message (see “Setting the fixed parameter of a MIDI message / `Val` field” on page 45). This field may take 9 values (`OFF` / `1` to `8`). When the field is set to the value *`OFF`*, none of the digital inputs control the behaviour of the MIDI message. In the other cases, the field takes the number of the associated digital input (1 to 8).

Selecting an alternative value / `Alt` field

`Alt: 0-127`

This field allows the user to control the alternative value of the fixed parameter of a MIDI message. If a TTL digital input is used and it is in state 1 (+5V), that is the value which is used as the fixed parameter of the MIDI message. This field is also used to specify the second controler number when a 10 bit value is transmitted with a *control change* message.

a

```
<  #1          Ch:16  >
Stat: ON       Var: +
Msg: N-ON      Val:40
MIDI Ch:2      Out:xOxO
```

b

```
<  #2          Ch:16   >
Aux:OFF        Alt: 45
Prm1:0         Prm2:0
Prm3:127
```

The two screens above illustrate the configuration of *analog input number 16* (screen **a**) and its control by *digital input number 2* (screen **b**). The MIDI message associated with the analog input is of the note on type (*N-ON*) and the MIDI note number is set to 40 (screen **a**). The alternative value is set to 45 (screen **b**).

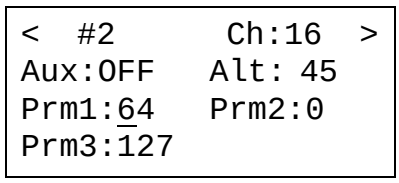
Thus, when digital input number 2 is in state 0 (zero volt), the analog signal generates MIDI note 40. If the digital input is in state 1 (five volts), the note played is MIDI note 45.

Several analog inputs may be controlled by the same digital input. The digital control signal may therefore be used to transpose or reconfigure all the notes which are generated by the different sensors or measuring devices.

Multipurpose parameter n° 1 / `Prm1` field

`Prm1: 0-127`

This field enables the user to configure the velocity of a note or the controller value for *note on with trigger threshold* or *controller value change with trigger threshold* messages.



Setting the velocity of note on with trigger threshold messages

Set the `Prm1` field to the value you want using the increment and decrement keys (*Inc.* et *Dec.*).

Setting the controller value of controller value change with trigger threshold messages

Set the `Prm1` field to the value you want using the increment and decrement keys (*Inc.* et *Dec.*).

Multipurpose parameters n° 2 and 3 / Prm2 and Prm3 fields

Prm2/Prm3: 0-127

This field enables the user to configure the trigger thresholds of *note on, controller value change with trigger threshold* and *program change with trigger threshold* messages.

```
<  #2      Ch:16  >
Aux:OFF   Alt: 45
Prm1:64   Prm2:40
Prm3:127
```

Setting the NOTE ON and NOTE OFF trigger thresholds

The Prm2 field configures the threshold above which a NOTE ON message is generated, while the Prm3 field configures the threshold below which a NOTE OFF message turns the note off. As long as the note hasn't been turned off (i.e. the signal stays above the NOTE OFF threshold), the note cannot be re-triggered.

For *note on* and *note on with trigger threshold* messages, Prm2 specifies the ripple tolerance for the envelope. The NOTE OFF threshold is then relative to the peak level of the envelope.

Setting the threshold for controller value change messages

The Prm2 field configures the threshold above which the fixed value of the MIDI controller is sent. The Prm3 field configures the threshold below which the controller value is set to zero. As long as the signal hasn't gone below the threshold specified by Prm3, the fixed value of the MIDI controller may not be sent again.

Setting the program change threshold

The Prm2 field configures the threshold above which the MIDI program change is sent. As long as the signal doesn't go below the threshold specified by Prm3, the MIDI program change message cannot be sent again.

Third menu for configuring the analog inputs (menu #3)

This menu is related to data filtering. ***AtoMIC Pro*** will basically output a MIDI message if the analog signal has changed in a relevant way. If the analog signal is not stable, many MIDI messages will be generated, slowing down the system. To get rid of this, digital values can be processed with a filter and a noise suppressor configurable in this menu.

```
<  #3      Ch:1   >
Filter:SUBSAMP
Nb Cycles:0
Noise Gate:8
```

Setting the filtering algorithm / `Filter` field

`Filter: SUBSAMP / SPEEDLIM`

This field enables the user to select the kind of filter he wants to use. SUBSAMP is a subsampling filter (also called downsampling filter). It will make ***AtoMIC Pro*** analyse the analog input not every scan cycle. Thus, fast changes on the signal will not be detected resulting a low-pass filter. The number of «wasted cycles» is configured in the `Nb Cycles` field.

The SPEEDLIM filter is a bit different : it will update the MIDI value only if the analog signal has remained stable for 'x' cycles. In that case also the number of cycles is setup in the `Nb Cycles` field.

Both filters affect the resolution of the MIDI message since some events might be masked by the algorithm. However, it avoids a reduction of the messages's bandwidth and ensures a low latency.

Setting the number of filtering cycles / `Nb Cycles` field

`Nb Cycles: 0-127`

This field enables the user to select the number of cycles needed for the filtering operation. If the number of cycle is zero, the filter is not active.

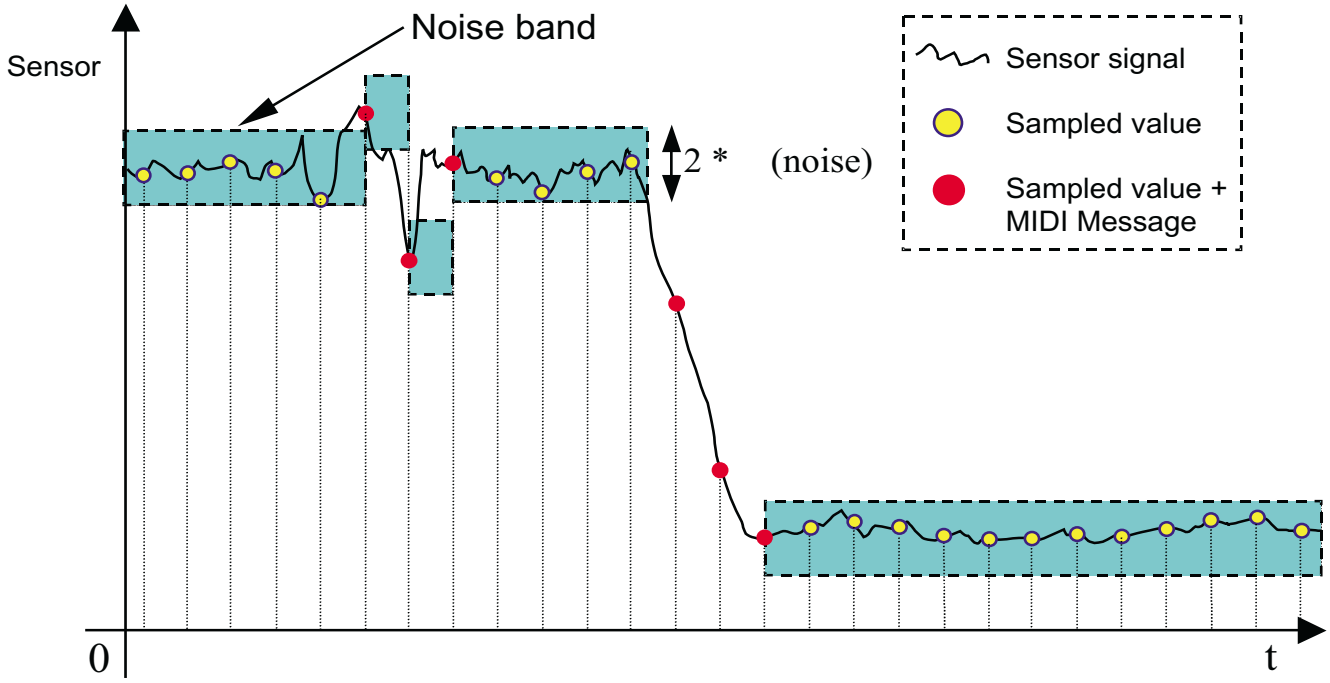
```
<  #3      Ch:1   >
Filter:SUBSAMP
Nb Cycles:10
Noise Gate:8
```

In the above screen, the analog input 1 is scanned every ten scan cycles. This parameter is particularly useful when the analog input is connected to a sensor or a measuring device which responds slowly, or for which a high sampling rate is not needed. Thus, fewer MIDI messages are generated, which leaves more bandwidth for higher priority analog inputs.

Setting the noise gate threshold / `Noise gate` field

```
Noise Gate: 0-127
```

The noise gate threshold specifies the variation of the analog signal that would be detected as a change. If the analog signal moves inside the range of the noise gate, no MIDI message will be sent.



This field enables the user to set the width of the range. A large range will be very effective against strong noise but will make the MIDI value less sensitive to a relevant change of the analog signal. For a reference voltage of +5V (see *Changing the reference voltage of the analog to digital converter*) a threshold of 8 corresponds to a noise level of ± 40 mV (ie : the analog has to change at least of 40 mV above or under its current position to be detected as changing). A threshold of 127 corresponds to a ribbon of ± 620 mV of noise[2].

```
<  #3      Ch:1   >
Filter:SUBSAMP
Nb Cycles:10
Noise Gate:8
```

[2] @ Vref = +5v.

Fourth menu for configuring the analog inputs (menu #4)

This menu is mainly related to data scaling. Version two of the ***AtoMIC Pro*** features a 10 bit analog to digital converter and this capability can be very useful for zooming the signal from the sensor, reducing the need to amplify it analogously.

```
<  #4        Ch:1   >
Res:7(L)  Table:LIN
Window:1024
Offset:0
```

Setting the data resolution / `Res` field

`Res : 7(L) / 10(H)`

This field enables the user to select the resolution of the data he wants to export to MIDI. When this field takes the value `7(L)`[3] the normal MIDI resolution is chosen while choosing the value `10(H)` selects a 10 bit resolution. When selecting the high resolution, the MIDI message `SysEx10` [4] is by default selected in `menu #1`, but can also be turned to a control change message (`C-Chg`) or a pitch bend message (`P-Bend`).

→ **NOTE about the high resolution :**

- For the pitch bend message, the 10 bits of the sampled value are mapped on the ten most significant bits of the MIDI message which actually counts 14 bits.
- For the control change message, the 3 Most Significant Bits (`MSB`) are sent via the alternate controller number (specified in `menu #2`, field `Alt`) whilst the "normal" controller number exports the 7 Least Significant Bits (`LSB`). To obtain the 10 bit value, the following calculation must be computed :

  10 bit value = (MSB controller value * 128) + LSB controller value

[3] 'L' here stands for « Low resolution », while 'H' stands for « High resolution ».
[4] Refer to section 4, Appendices, for more details about the structure of this message.

Setting the lookup table / `Table` field

```
Table : LIN / LOG / EXP / SPE
```

This field allows the user to apply a mathematical function to the sampled value[5]. Four lookup tables (also named conversion tables) are available : Linear, Logarithmic, Exponential or Special. The linear table actually does not affect the value. The special table allows the user to specify is own function[6] , the table's content being dumped in by a System Exclusive Message (see "Section 4 - Appendices" on page 73). Dumping out the current custom table is achieved by pressing both Inc. and Valid. keys at startup. The message "Export custom table" will be briefly displayed.

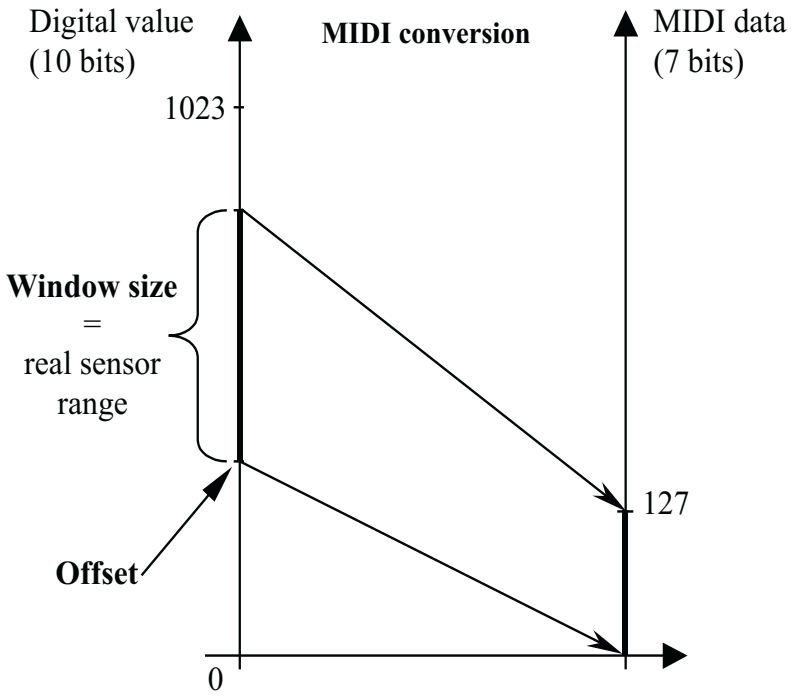
The table feature is very useful for changing the response of a sensor. A linear response can be obtained from a logarithmic sensor by applying an exponential function, and vice-versa.

Setting the window size and offset / `Window` and `Offset` fields

```
Window : 128 / 256 / 512 / 1024
Offset : [0 ; (Window / 2) – 1]
```

Those two parameters specify how the real range of an analog input can be mapped on a seven bit MIDI value. As a matter of fact, a sensor does not necessary have a range equal to the reference voltage of the Analog to Digital Converter (see "Changing the reference voltage of the analog to digital converter / `ADC Vref` field" on page 61). In version 2.0 we have implemented a custom scaled zoom on the digital value to take advantage of the 10 bit resolution of the A/D converter. First, the voltage reference has to be set to the largest range among the sensors connected to the unit. Then, the user can select the sensor's range within the 10 bit dynamic by specifying a window size and an offset. The selected range can then be converted into 7 bit MIDI data without greatly increasing the quantification step, as shown in the next illustration.

5. Only in the low resolution mode.
6. The table can be drawn within the Max software (patch provided with the unit)



NOTE :

Only exponent-two sizes are available for the window size (128, 256, 512 and 1024). Nevertheless, this allows enough flexibility in most cases, since the offset can be set with accuracy.

Fifth menu for configuring the digital inputs (menu #5)

To get to this configuration menu from the fourth configuration menu for the analog inputs, move the flashing cursor towards the right arrow.

```
< #5     Digital >
Digital inputs:OFF
Msg:No Msg Val:7
MIDI Ch:1 Out:xxxO
```

Digital input status / `Digital inputs` field

```
Digital inputs : ON / OFF
```

The `Digital inputs` field is used to tell ***AtoMIC Pro*** if the digital inputs should be interpreted or not. If the field is set to `OFF`, variations in the state of the digital inputs are not taken into account, even if one or more of them have been assigned to control the analog inputs If the field is set to `ON`, the digital inputs are taken into account.

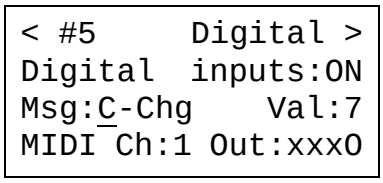
```
< #5     Digital >
Digital  inputs:ON
Msg:No Msg   Val:7
MIDI Ch:1 Out:xxxO
```

Choosing the MIDI message to be associated with the digital inputs / `Msg` field

```
No Msg
C-Chg / P-Bend
Af-Tch1 / Af-Tch2
SysEx7 /SysEx8
```

This field determines which MIDI message is associated with each digital input when these are used in one byte blocks. If this field is set to `No Msg`, no MIDI message can be generated, even if the digital inputs change state.

The other field values associate a MIDI message with variations in digital input levels, as long as these are active (the `Digital inputs` field is set to `ON`).



To find out how the MIDI messages in this field work, refer to the beginning of this section, to the paragraph entitled *Choosing a MIDI message /* `Msg` *field*.

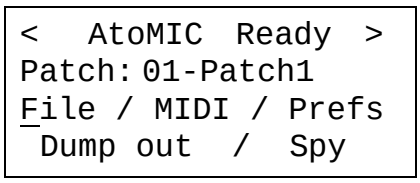
MIDI message parameters for the digital inputs / `Val, MIDI Ch` and `Out` fields

These parameters are identical to those used for configuring MIDI messages associated to the analog inputs. Refer to the beginning of this section, to the paragraph entitled *Main menu for configuring the analog inputs* to find out what these parameters mean.

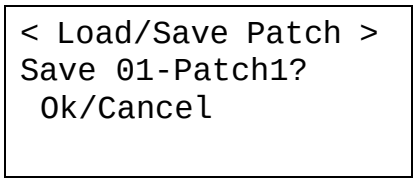
Saving, loading and copying configuration patches

Saving / loading a configuration patch

If you wish to load or save the configuration of the interface, go to the welcome screen using the *arrow keys* Move the flashing cursor onto the `File` field, and press on the *Valid* key to access the File screen.



[Valid.]



Move the cursor on the first line on which two fields can be reached. The first field enables to select a load or a save operation (use Inc. and Dec. keys to change the desired operation). The second field selects the number of the patch you want to load/save (15 available setups in the non-volatile memory). To start the load/save operation, move the cursor on the third line, on the **`Ok`** field then press the Valid. key.

The load operation is immediate while the saving operation takes approximately 3 or 4 seconds. When saving, a new screen is displayed, showing the status of the saving process. When the saving process is finished, the interface automatically goes back to the welcome screen.

```
Saving Patch #1
Done
```

[...]

```
<  AtoMIC  Ready  >
Patch: 01-Patch1
File / MIDI / Prefs
 Dump out  /  Spy
```

You can cancel the saving operation as long as you haven't validated the `Yes` field with the *Valid* key. To cancel the saving operation, valid the `No` field, or move the cursor with the arrows to the first line of the liquid crystal display. These two operations are equivalent and enable the user to go back to the welcome screen.

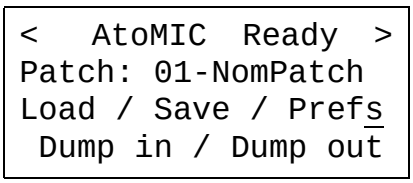
```
<    Save Patch    >
Save 01-Patch1  ?
 Sure ? Yes/No
```

Copying a configuration patch

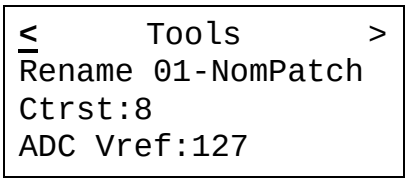
To copy a patch into another space in memory, first load the patch to be copied (see further up). Save this patch making sure you choose the right destination patch number for the copy and that you are not overwriting a patch you would like to keep.

Changing the name of a patch, the contrast of the Liquid Crystal Display, and the reference voltage of the Analog to Digital Converter

From the welcome screen, move the cursor onto the `Prefs` field and press on the *Valid* key.



[Valid.]



Changing the name of a patch / `Rename` field

Move the cursor onto the `Rename` field using the arrow keys. This field is made up of eight sub-fields; each one corresponds to an alphanumerical character and together they form the name of the patch.Write the name of the configuration patch by choosing the characters you want using the parameter increment and decrement keys.

```
<      Prefs      >
Rename 01-Test1
Ctrst: 08
ADC Vref:127
```

[4 x Inc.]

```
<      Prefs      >
Rename 01-Test5
Ctrst: 08
ADC Vref:127
```

It is not necessary to save the modifications made to the name of the patch: saving in this case is automatic.

Contrast of the Liquid Crystal Display (LCD) / `Ctrst` field

`Ctrst: 1-16`

Move the cursor onto the `Ctrst` field and change the value of the field to suit the setting you want. The value 1 corresponds to minimum contrast, and 16 to maximum contrast.

Changing the reference voltage of the analog to digital converter / `ADC Vref` field

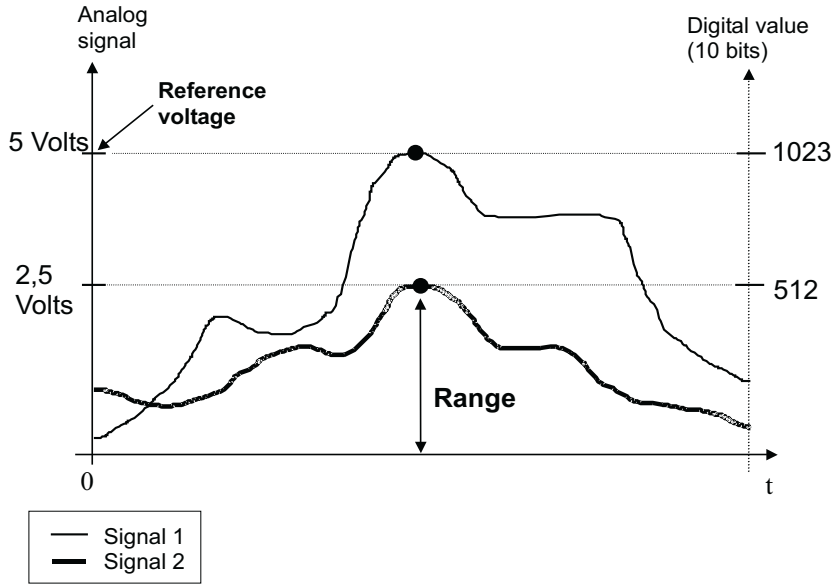
`ADC Vref: 0-127`

→ **General remarks**

The Analog to Digital Converter is one of the main parts of ***AtoMIC Pro***. It is the Analog to DigitalConverter which provides a link between the analog world of measuring devices to the digital world of the MIDI standard.

Broadly speaking, a converter has a measuring scale which relates the digital output value (without a unit) to the analog signal level (in volts). This relationship is specified by a reference voltage. This reference voltage dictates what the dynamics of the analog signals may be (i.e. their maximum amplitude) which must be equal to the reference voltage. If the dynamics are smaller than the reference voltage, then part of the resolution of the converter is never used; in this case, the MIDI messages would lack precision, and could never reach their maximum value.

In order to adapt to different signal dynamics, the converter used by ***AtoMIC Pro***, which has a resolution of 10 bit (1024 digital values possible), has an adjustable reference voltage Its setting affects all of the analog inputs, since they are multiplexed, and there is only one converter.



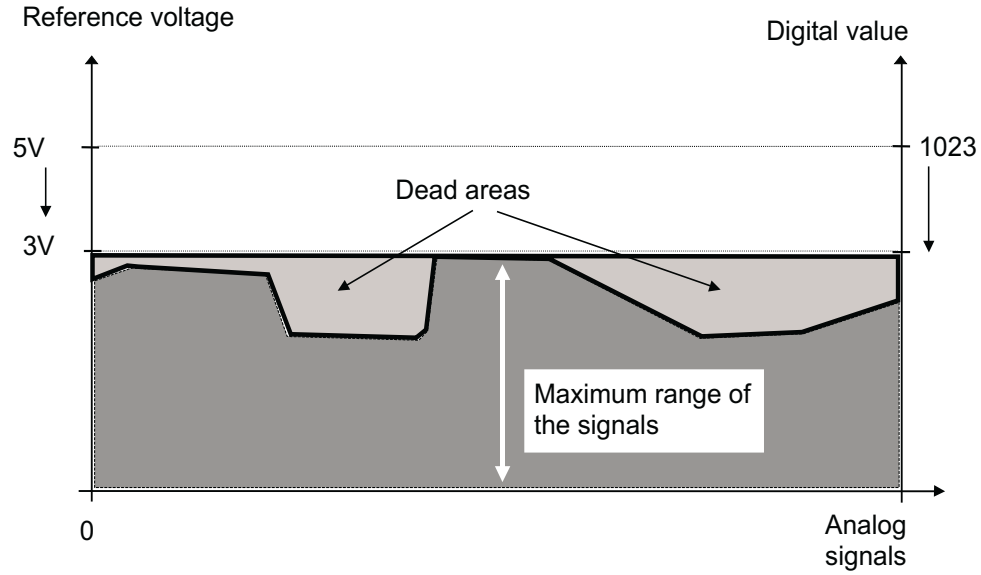
The above example shows two signals changing with time, and a reference voltage set to five volts. Signal **1** has a maximum level equal to the reference voltage, and the scale of digital values is fully used. Signal **2** however, has a maximum level of 2.5 volts. The result of the analog / digital conversion will give values between 0 and 512 only: half of the resolution of the converter is not used.

With ***AtoMIC Pro***, the reference voltage can be adapted to the analog signals to be converted; if, however, the signals have very different maximum levels, the weaker signals have to be amplified.

Broadly speaking, the reference voltage should be aligned with the analog input with the highest level.

WARNING:

The analog signals must never exceed the reference voltage of the converter. This could damage it.



In the above example, the maximum level of the signals being 3 volts, the reference voltage has been set to the same level. Certain other signals have lower maximum values, which means there are some *dead areas* in the resolution of the converter. It is recommended that these areas be eliminated by amplifyingthe relevant analog signals.

NOTE:

It is possible to get rid of the dead areas by setting the zooming scale for the signal. This method is however not always as efficient as an analog amplification.

Refer to the paragraph entitled “Setting the window size and offset / `Window` and `Offset` fields” on page 54 for more details on this operation.

→ Adjustment

Move the cursor onto the `ADC Vref` field and modify the value of the field according to the reference level you want.

```
<      Prefs       >
Rename 01-NomPatch
Ctrst:8
ADC Vref:114
```

The reference level is coded to give a value between 0 and 127. The value zero corresponds to a reference voltage of 0 volts, and 127 to a reference voltage of 5 volts. Intermediate values modify the reference voltage in 39 mV steps, approximately.

→ NOTE :

Conversion table

Reference voltage (volts)	Field `ADC Vref (± 1)`
1.50	38
1.75	44
2.00	50
2.25	57
2.50	63
2.75	70
3.00	76
3.25	83
3.50	89
3.75	95
4.00	102
4.25	108
4.50	114
4.75	121
5.00	127

It is possible to adjust the reference voltage between 0 and 5 volts, but **you are advised to keep it between 1.5 and 5 volts** (values 38 to 127) to maintain immunity to noise. If the analog signals used do not reach a maximum level of 1.5 volts, you will have to amplify them in the analog domain beforehand.

The reference voltage is a global parameter and cannot be saved for each individual configuration patch.

Changing the MIDI preferences of the unit

This menu enables to setup parameters related with the MIDI configuration of the unit.

```
<  AtoMIC  Ready  >
Patch: 01-Patch1
File / MIDI / Prefs
 Dump out  /  Spy
```

[Valid.]

```
<   MIDI Prefs   >
Program Nb:1
MIDI Ch:16    ID:1
Ctrl1:64   Ctrl2:65
```

Setting the identification number of the unit / `ID` field

`ID : 1-16`

Changing the unit ID is useful when several ***AtoMIC Pros*** are connected on the same MIDI port. As a matter of fact, the *System Exclusive* messages contain a byte that indicates to which unit the message is destined. Change the ID value if you wish to distinguish one unit from the other when they are receiving a *System Exclusive* message from the same MIDI link [7].

Setting the receive MIDI channel / `MIDI Ch` field

`MIDI Ch : 1-16`

Since ***AtoMIC Pro*** accepts standard MIDI messages such as *control change* and *program change*, a MIDI channel must be associated to the unit(s) especially when several MIDI devices share the same MIDI port. Change the value of the MIDI channel of the unit if it is already used by another device[8] .

[7] Especially when sending a SysEx message dumping in a configuration
[8] By default, the receive MIDI channel is set to 16 to avoid conflict.

Setting the MIDI controller numbers / `Ctrl1` and `Ctrl2` fields

`Ctrl1 / Ctrl2 : 0-127`

Those two controller numbers can be used to control the eight digital outputs. In version 1 of ***AtoMIC Pro***, only *System Exclusive* messages allowed the control of the digital outputs. Version 2 allows the control of the outputs via standard MIDI control change message. Since MIDI data are only 7 bits long, control was splitted into two nibbles in two different messages : the 4 least significant bits (LSB) are controlled by `Ctrl1` while the 4 most significant bits (MSB) are controlled by `Ctrl2`.

→ **NOTE :**

Since each controller is only driving 4 bits, their value should be between 0 and 15.

Setting the program number / `Program Nb` field

`Program Nb : 1-128`

The ***AtoMIC Pro*** device can store up to 15 different setups in its non-volatile memory. Changing from one setup to another was previously achieved by a *System Exclusive* message (in version 1). This feature is still working, but loading a configuration patch can also be performed by sending a standard *program change* MIDI message to the unit. This is particularly useful for controlling the ***AtoMIC Pro*** with MIDI foot pedals sending such a message.

Use the `Program Nb` field to associate a program number with the current configuration patch.

Section 3 - Connections using MIDI

This section shows different connections which are possible with ***AtoMIC Pro*** and compatible MIDI systems.

Before plugging the device into MIDI peripherals

Before connecting ***AtoMIC Pro*** to any MIDI peripheral, make sure you have read the following information.

Compatibility

Before connecting the device to one or more MIDI peripherals, make sure they are all compatible with ***AtoMIC Pro***. Have a look at the MIDI compatibility chart for the device which is drawn up in section 4 (*Appendices*).

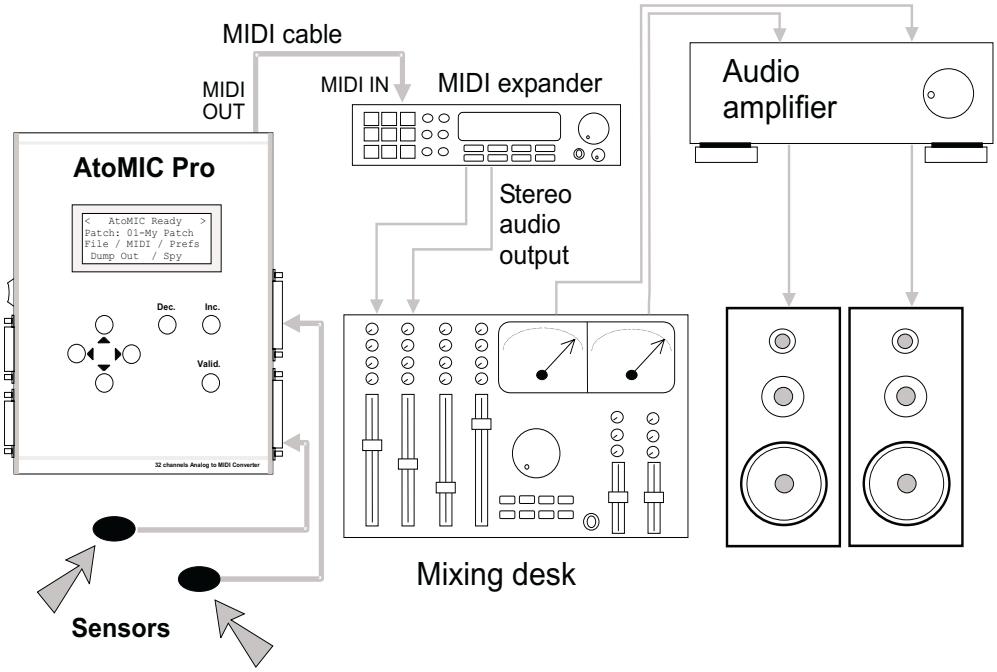
Also make sure that the MIDI connection cables are standard cables. Using non-standard or faulty cables may damage ***AtoMIC Pro*** as well as the MIDI peripherals connected to it.

Connecting to sound production equipment

During this operation, you are advised to turn ***AtoMIC Pro*** off as well as the devices you want to plug into it. When using the device, if it is plugged into any sound producing equipment it is advised that you keep the volume down at a reasonable level. Poor manipulation of ***AtoMIC Pro*** along with hazardous handling of the sensors or the measuring equipment may lead to dangerous sound levels for people nearby, as well as for the equipment itself, especially the loudspeakers.

Basic configuration

The simplest configuration is made up of a group of sensors or other measuring devices, and a sound production system (MIDI expander for example).



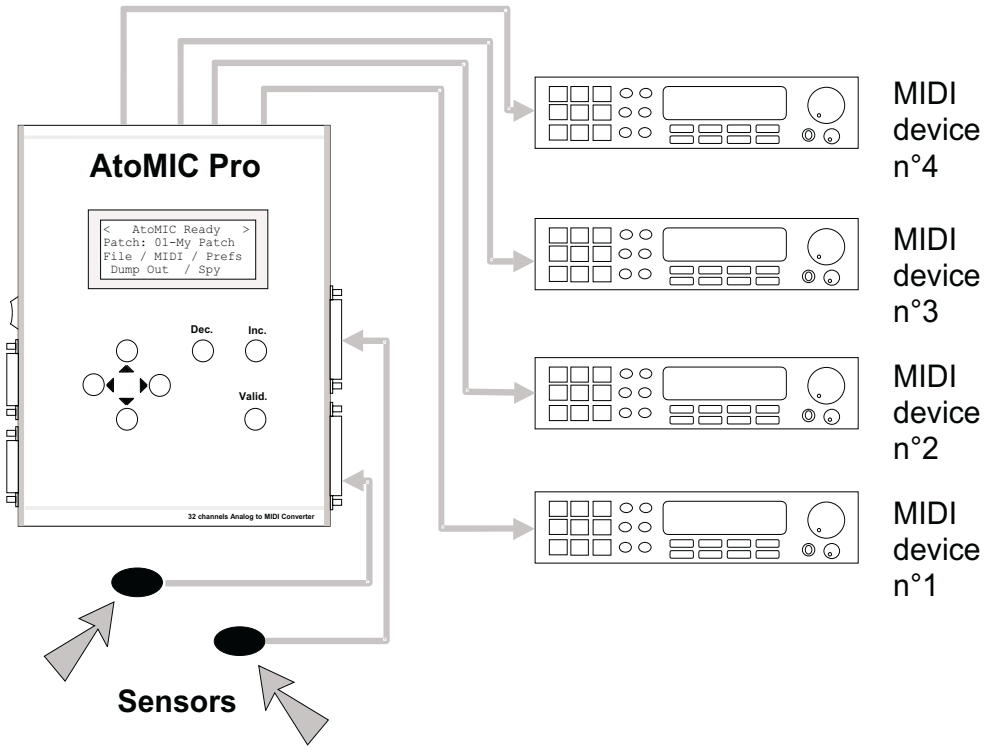
The mixing desk shown in the above illustration may of course be used to mix audio signals coming from other sound production systems which aren't linked to ***AtoMIC Pro***.

→ **NOTE :**

For MIDI connections, make sure you use standard MIDI cables only.

Multiple MIDI connections

AtoMIC Pro has four independent MIDI outputs. This means up to four MIDI devices can be connected to the analog-to-MIDI interface.

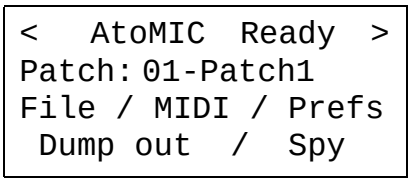


Connecting to a computer

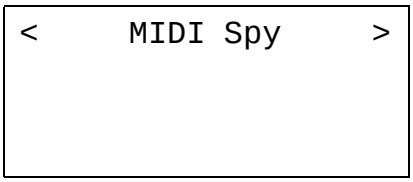
When ***AtoMIC Pro*** is to be used with a computer for sending and receiving MIDI messages, you should use a MIDI interface. Refer to your computer documentation for further information, or if you have doubts about its compatibility with the MIDI standard.

MIDI Spy

The MIDI Spy is accessible from the welcome screen. Move to the Spy item with the keypad arrows, then press the Valid. key.



[*Valid.*]

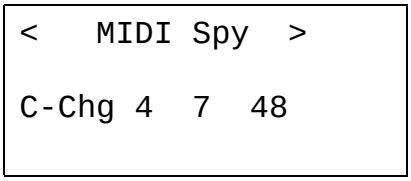


This screen allows the user to monitor any entering MIDI message, including System Exclusive messages. This can be very useful for checking debugging a MIDI installation without a computer.

The messages are displayed on the third line of the LCD :

Message Type – MIDI Channel – Data Byte 1[9] – Data Byte 2[10]

For instance, the next screen displays a *Control Change* message on channel 4, controller number 7 for a value of 48.



[9] Note number, controller number or program number for instance. Refer to the MIDI standard specifications for more details on the structure of a MIDI message.

[10] Optional (Some MIDI messages are composed only of two bytes). Note velocity or controller value, for instance.

→ **NOTE 1 :**

In the case of a System Exclusive message, only the first nine bytes will be displayed on the LCD

→ **NOTE 2 :**

Display errors may occur when a MIDI activity which is too strong appears in MIDI Spy mode. Display can be cleared and reset by pressing the Valid. key.

→ **NOTE 3 :**

While in the MIDI Spy screen, analog to MIDI conversion will still be active but slower if MIDI messages enter the device and are displayed[11] .

[11] Displaying data on the LCD consumes a lot of processing time.

Section 4 - Appendices

These appendices give further information about the System Exclusive protocol used for exchanging information between ***AtoMIC Pro*** and other MIDI devices.

This section also shows some practical examples using ***AtoMIC Pro***.

Appendices Content

- MIDI implementation chart.
- Design specification.
- Dump using System Exclusive messages.
- Max objects and patches:
  - Installation
  - Configuration patch
  - Dynamic control patches
- In case of problems...
- Replacing the fuse and the mains adapter.
- Restoring the factory settings.
- Powering with batteries.
- Amplifying analog voltages.
- Design examples:
  - Running lights controlled by MIDI
  - Using a Force Sensing Resistor (FSR)
  - MIDI "mixing desk"
  - Using piezoelectric sensors
- List of MIDI controllers.

Analog to MIDI Converter
Model: ***AtoMIC Pro***

Date: june 2002
Version : 2.00

MIDI IMPLEMENTATION CHART

Function ...		*Transmitted*	*Recognised*	*Remarks*
Basic Channel	Default Changed	* 1-16 * 1-16	x x	memorised
Mode	Default Messages Altered	Mode 3 x x	x x x	
Note Number :	True voice	* 0-127 * 0-127	x x	memorised
Velocity	NOTE ON NOTE OFF	1-127 64	x x	
After Touch	Key's Channel's	o o	x x	
Pitch Bender		o	x	10 bit resolution
Control change		* 0-127	x	memorised
Program Change		* 0-127	x	Program number 1-128
System Exclusive		o	o	
System Common	Song Pos Song Sel Tune	x x x	x x x	
System Real Time	Clock Commands	x x	x x	
AUX Messages	Local ON/OFF All Notes OFF Active sense Reset	x x x x	x x x x	

Mode 1 : OMNI ON, POLY Mode 2 : ONMI ON, MONO
Mode 3 : OMNI OFF, POLY Mode 4 : OMNI OFF, MONO

O: Yes
x: No

Design specification

AtoMIC Pro **: Analog to MIDI converter**

Analog / Digital Conversion

- 10 bits, by successive approximation.
- Conversion latency for 32 active inputs: 110 µs per active input.

Analog inputs

- Number of inputs: 32.
- Impedance: 1 MΩ.
- Input voltage: 0-5 V.
- Minimum level: 1,5 V.
- Maximum level : 5 V.

Digital inputs

- Number of inputs: 8.
- Compatibility: TTL and CMOS.
- Pull up impedance for +5V: 4,7 kΩ.

Digital outputs

- Number of outputs: 8.
- Compatibility: TTL and CMOS.
- Output current: 10 mA.

Display

- Liquid crystal display.
- 4 lines of 20 characters.
- Yellow / green backlite.

User interface

- 4 arrow keysfor scrolling through menus (blue keys).
- 2 keysfor changing parameters (red keys, *Inc* and *Dec*).
- 1 validation key (green key, *Valid*).
- 1 switch (on / off for the backlite of the liquid crystal display).

Memory saving

- 15 configuration setups.

Indicators

- Power ON indicator.
- MIDI OUT data indicators (4).
- MIDI IN data indicator.

Connectors

- 12V DC PSU, 2.1 mm *Canon* connector.
- MIDI IN.
- MIDI OUT (4).
- Analog inputs, 25 pin female SUB-D connectors (2).
- Digital inputs, 15 pin female SUB-D connector.
- Digital outputs, 15 pin female SUB-D connector.

Power supply

- 12 V DC / 800 mA mains adapter.

Dimensions

- 165 (l) x 225 (P) x 38 (h) mm.
- 6.5" (W) x 8.86" (D) x 1.5" (H)

Weight

- 740 grams (without the mains adapter).

Accessories

- User manual.
- Mains adapter in compliance with European safety norms (220 V AC / 12 V DC).
- Patches for the Max/MSP program.

Optional

- Easy connect breakout box.

Dump using MIDI System Exclusive messages

There are two ways of configuring ***AtoMIC Pro*** **:**

- By using the User interface (keypad and liquid crystal display).
- By using *System Exclusive* messages (configuration dump received via the MIDI IN input).

A MIDI dump is used not only to receive, but also to send configuration patches from ***AtoMIC Pro*** using a MIDI connection. This configuration information is specific to the device, and is therefore transmitted using MIDI System Exclusive messages which is what they are made for in the first place.

With the exception of System Exclusive encapsulation defined by the MIDI standard, the MIDI dump message contains configuration parameters as they stand in the memory of ***AtoMIC Pro***.

```
; Dump (semicolons indicate comments)
; -----

0xF0 ; Beginning of SysEx   .....

0x00 ; SysEx ID (Ircam)
0x20
0x39   ........................

Device ID ; Indicate which device has to receive the dump
0x7F; SysEx Function number (dump message identifier)
PatchName1; 8 ASCII caracters
PatchName2; to export the name of the patch
PatchName3; being dumped
PatchName4;“““
PatchName5;“““
PatchName6;“““
PatchName7;“““
PatchName8;“““
ADC Vref; ADC reference voltage
Current device ID
MIDI channel; Receive MIDI channel
Ctrl1; Logic outputs controller number (LSB)
Ctrl2; Logic outputs controller number (MSB)

Digital_setup*; Digital inputs configuration
Digital_MIDI_ch*
Digital_msg_value

Last_sampled_value_L†*
Last_sampled_value_H†*
Filter*
Filter counter†*
Noisegate*
Draft_L†*
Config1*
Config2*
Param1*
Alternate*
Draft_H†*
Config4a*
Config4b*
ParamMulti1*
ParamMulti2*
ParamMulti3*
; Next analog channel (32 iterations)

0xF7            ; End of SysEx
```

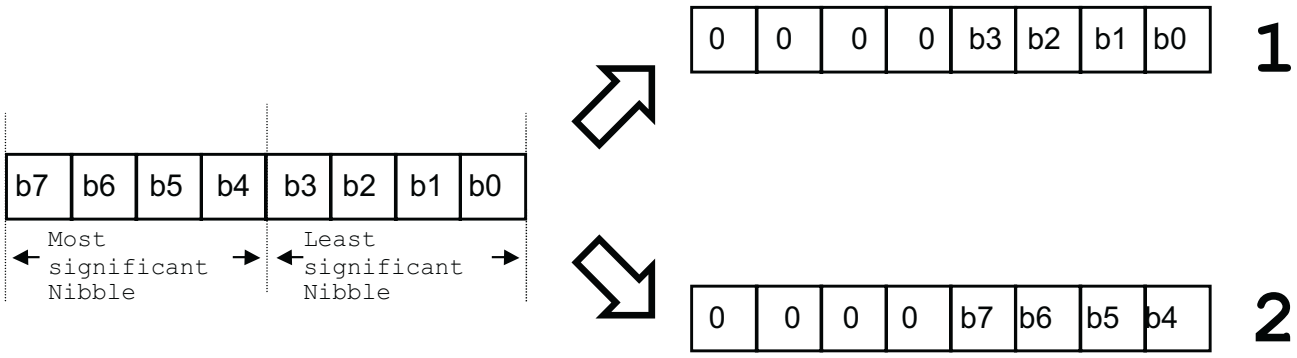
System Exclusive encapsulation

* Data to be transferred in two nibbles (see following page)

† Not useful. Set to zero when dumping to the ***AtoMIC Pro***.

NOTE :

When a byte is to be transmitted in two operations (cut into two nibbles, or 4 bit packets), the least significant nibble is sent first, and then the most significant one. A nibble is transmitted in the least significant four bits of a byte, the most significant ones are set to 0.



Description of the layout of an *AtoMIC Pro* configuration patch

In order to facilitate sending and receiving configuration patches using MIDI *System Exclusive* messages, the dump message is made an exact copy of what is in the memory of ***AtoMIC Pro***. Since a byte in memory can contain several configuration parameters, the following pages detail how the memory bytes are used, bit by bit. The parameter(s) contained in a byte are recalled by the field shown on the liquid crystal display. The name of the variable in memory (name of the byte) is also shown.

Analog inputs

Summary of the analog input parameters

- Active or inactive channel (`Stat` field).
- Type of MIDI message to be sent (`Msg` field).
- MIDI channel of the message (`MIDI Ch` field).
- Physical output of the MIDI message (`Out` field).
- Direction of signal variation (`Var` field).
- Number of the control bit of an analogue channel by a bit of the digital input (`Aux` field).
- Five parameters which give the content of the MIDI message (`Val`, `Alt`, `Prm1`, `Prm2` and `Prm3` fields).
- Filter type (`Filter` field)
- Filter iteration number (`Nb Cycles` field)
- Noise gate threshold (`Noise Gate` field)
- Window size (`Window` field)
- Window offset (`Offset` field)
- Resolution (`Res` field)
- Lookup table (`Table` field)

Layout in memory of the configuration data for the analog inputs

Filter

b7	b6	b5	b4	b3	b2	b1	b0

```
Bit 7 :
  - 0 <=> Subsampling filter
      (Filter field = SUBSAMP)
  - 1 <=> SpeedLim filter
      (Filter field = SPEEDLIM)
Bits 6-0 : Filter iteration number
      (Nb Cycles field)
```

Noisegate

b7	b6	b5	b4	b3	b2	b1	b0

```
Bit 7 :
  - 0 <=> 7 bit MIDI resolution
      (Res field = 7(L))
  - 1 <=> 10 bit high resolution
      (Res field = 10(H))
Bits 6-0 : Noise gate threshold
      (Noise Gate field)
```

Config1

b7	b6	b5	b4	b3	b2	b1	b0

```
Bit 7 (Stat field):
  - 0 <=> Status = OFF
  - 1 <=> Status = ON
Bit 6 :
  - 0 <=> Positive variation
      (Var field = +)
  - 1 <=> Inverse variation
      (Var field = -)
Bits 5-4 : Window Size (Window field)
Bits 3-0 : Aux selection
      (Aux field)
```

5th bit	4th bit	Window Size
0	0	128
0	1	256
1	0	512
1	1	1024

Config2

b7	b6	b5	b4	b3	b2	b1	b0

Bits 7-4 : MIDI channel (MIDI Ch field)
Bits 3-0 : MIDI message (Msg field)

b3	b2	b1	b0	Control by a digital input
0	0	0	0	OFF
0	0	0	1	Bit 1
0	0	1	0	Bit 2
0	0	1	1	Bit 3

Param1

b7	b6	b5	b4	b3	b2	b1	b0

Bit 7 : 0
Bit 6-0 : Note/Program/controller number (Val field)

Alternate

b7	b6	b5	b4	b3	b2	b1	b0

Bit 7 : 0
Bit 6-0 : alternate Note/Program/ controller number (Alt field

Config4a

b7	**b6**	**b5**	**b4**	b3	b2	b1	b0

Bits 7-4 : Physical output selection (Out field)

7th bit	6th bit	5th bit	4th bit	Selected output(s)
0	0	0	0	xxxxx
0	0	0	1	xxxO
0	0	1	0	xxOx
0	0	1	1	xxOO
0	1	0	0	xOxx
0	1	0	1	xOxO
0	1	1	0	xOOx
0	1	1	1	xOOO
1	0	0	0	Oxxx
1	0	0	1	OxxO
1	0	1	0	OxOx
1	0	1	1	OxOO
1	1	0	0	OOxx
1	1	0	1	OOxO
1	1	1	0	OOOx
1	1	1	1	OOOO

→ **NOTE :**

x <=> non selected output
O <=> selected output

b7	b6	b5	b4	**b3**	**b2**	b1	b0

Bits 3-2 : Lookup table selection (Table field)

3rd bit	2nd bit	Lookup Table
0	0	Linear
0	1	Logarithmic
1	0	Exponential
1	1	Custom

b7	b6	b5	b4	b3	b2	**b1**	**b0**

Bits 1-0 :
2 Most Significant Bits (MSBs) of the window offset value

Config4b

8 Least Significant Bits (LSBs) of the window offset value

Param Multi1 :

b7	b6	b5	b4	b3	b2	b1	b0

Bit7 : 0
Prm1 / b6-b0 :
multipurpose parameter (fixed controller or velocity value [0-127])

Param Multi2 :

b7	b6	b5	b4	b3	b2	b1	b0

Bit7 : 0
Prm2 / b6-b0 :
parameter value [0-127]

Param Multi3 :

b7	b6	b5	b4	b3	b2	b1	b0

```
Bit7 : 0
Prm3 / b6-b0 :
      parameter value [0-127]
```

Digital inputs

Summary of the digital input parameters

- Active or inactive digital inputs (`Digital inputs` field).
- Type of MIDI message to be sent (`Msg` field).
- First parameter of the MIDI message (`Val` field).
- MIDI channel of the message (`MIDI Ch` field).
- Physical output of the MIDI message (`Out` field).

Layout in memory of the configuration data for the digital inputs

`Digital inputs, Out` and `Msg` fields (**digital_setup**) :

b7	b6	b5	b4	b3	b2	b1	b0

```
Bit 7 : digital inputs ON/OFF
        (Status field)
Bits 6-4 : 0
Bits 3-0 : MIDI message
           (Msg field)
```

MIDI message	*b3*	*b2*	*b1*	*b0*	*Message number (coded over 4 bits)*	*Notation on the liquid crystal display*
• No message	0	0	0	0	0	No-Msg
• Control number change	0	0	0	1	1	C-Chg
• Pitch change	0	0	1	0	2	P-Bend
• Polyphonic pressure	0	0	1	1	3	Af-Tch1
• Channel pressure	0	1	0	0	4	Af-Tch2
• 7 bit exclusive message	0	1	0	1	5	SysEx10

MIDI Ch field (**digital_MIDI_ch**) :

b7	b6	b5	b4	b3	b2	b1	b0

Bits 7-4 : Physical outputs (Out field)
Bits 3-0 : MIDI Channel (MIDI Ch field)

7th bit	6th bit	5th bit	4th bit	Selected output(s)
0	0	0	0	xxxxx
0	0	0	1	xxxO
0	0	1	0	xxOx
0	0	1	1	xxOO
0	1	0	0	xOxx
0	1	0	1	xOxO
0	1	1	0	xOOx
0	1	1	1	xOOO
1	0	0	0	Oxxx
1	0	0	1	OxxO
1	0	1	0	OxOx
1	0	1	1	OxOO
1	1	0	0	OOxx
1	1	0	1	OOxO
1	1	1	0	OOOx
1	1	1	1	OOOO

Val field (**digital_msg_value**) :

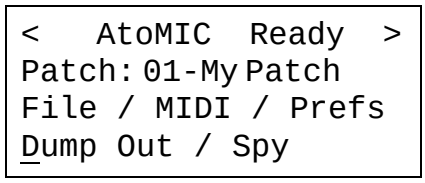
b7	b6	b5	b4	b3	b2	b1	b0

Bits 7 : 0
Bits 6-0 : fixed parameter of the MIDI message (note number, controller or program number [0-127]

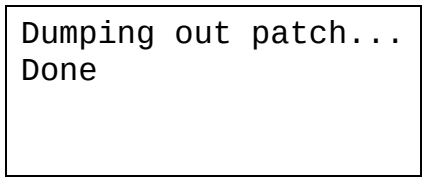
Sending a dump with *AtoMIC Pro*

Sending a dump message enables the user to export the current configuration patch. The dump data is sent to **all MIDI outputs** of ***AtoMIC Pro***.

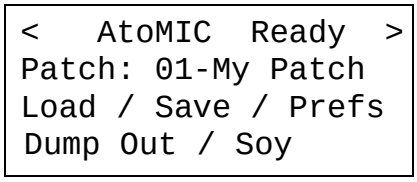
From the welcome menu go to the Dump Out item using the arrow keys and the *Valid* key.



[*Valid.*]



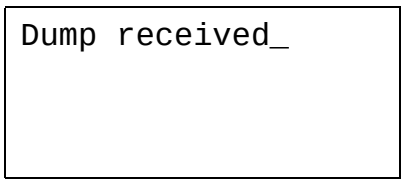
[...]



Receiving a dump with *AtoMIC Pro*

Receiving a dump is dynamic.

When a dump message has been received without errors, the following screen is shown briefly:



Exchanging dump messages

To exchange configuration patches between two ***AtoMIC Pro*** interfaces, all you need to do is connect MIDI cables from the input of one to the output of the other (or the opposite depending on which is the sender and which is the receiver of the dump). Don’t forget to save the patch on the receiving unit.

Dynamic control of the *AtoMIC Pro* interface using MIDI System Exclusive messages

System Exclusive messages, received via the MIDI IN input, allow the user to dynamically control the behaviour of ***AtoMIC Pro***. This can be done using MIDI equipment or software which is capable of generating MIDI System Exclusive messages (like sequencers for example). Some patches have been developed especially for a piece of software called Max, to simplify the generation of these messages (see the chapter “Max objects and patches” on page 95).

Activating / Desabling an analog input

This instruction enables the user to change the status of an analog input. It enables or disables the analog to MIDI conversion of a particular signal. This instruction is identical to changing the status of an analog input from the user interface in the main configuration menu (`Stat: ON/OFF`).

```
0xF0  ; Beginning of SysEx

0x00  ; SysEx ID
0x20
0x39

Atomic Pro ID (1-16)
0x7E  ; SysEx function number (activation / deactivation
      ;identifier of an analog input)

Input number ; Number of the input whose status is being modified
(1-32)
Status; Desired status: 0 <=> inactive input / 1 <=> active input

0xF7  ; End of SysEx
```

Loading a patch

The instruction for loading a patch enables the ***AtoMIC Pro*** interface to load a configuration already saved in non-volatile memory. This instruction is identical to loading a configuration from the user interface (*Load* menu).

```
0xF0  ; Beginning of SysEx

0x00  ; SysEx ID
0x20
0x39

Atomic Pro ID (1-16)

0x7C ; SysEx function number (patch load identifier)

patch N° ; Number of patch to be loaded (1-20)

0xF7      ; End of SysEx
```

→ **NOTE 1 :**

You are advised to perform the loading of patch operations only when the sensors or measuring devices connected to the device are at rest.

→ **NOTE 2 :**

For optimisation reasons, the liquid crystal display is not automatically updated during a load operation or an activation / deactivation of an analogue input with MIDI. The liquid crystal display is updated when a menu is changed from the ***AtoMIC Pro*** keyboard.

Saving the current patch

```
0xF0 ; Beginning of SysEx

0x00 ; SysEx ID (Ircam)
0x20
0x39

Device ID ; Indicate which device has to receive the SysEx message
0x7B; SysEx Function number (save current patch identifier)

0xF7; End of SysEx


Rebooting AtoMIC Pro

0xF0 ; Beginning of SysEx

0x00 ; SysEx ID (Ircam)
0x20
0x39

Device ID ; Indicate which device has to receive the SysEx message
0x7A; SysEx Function number (reset unit identifier)

0xF7; End of SysEx
```

Exporting† the custom lookup table

```
0xF0 ; Beginning of SysEx

0x00 ; SysEx ID (Ircam)
0x20
0x39

Device ID ; Indicate which device has to receive the SysEx message
0x79; SysEx Function number (save current patch identifier)

128 values to be read / written (table content)*

0xF7; End of SysEx
```

† From or to ***AtoMIC Pro***. Protocol is the same for a custom table dump in or dump out.

* Those 128 bytes must be 7 bit long. The seventh bit must be cleared.

Control of the digital outputs

The control is done by sending ***AtoMIC Pro*** one byte of information on the status of the digital outputs. One bit set to 1 shows that the corresponding output is active (+5V), whereas a bit set to 0 corresponds to an inactive output (0V).

b7	b6	b5	b4	b3	b2	b1	b0

```
0xF0 ; Beginning of SysEx

0x00 ; SysEx ID
0x20
0x39

Atomic Pro ID (1-16)
0x7D ; SysEx function number (digital outputs control identifier)

Byte containing the status of the digital outputs **
0xF7 ; End of SysEx
```

** Data to be transferred in two nibbles.

SysEx10 System Exclusive message

The different MIDI messages which can be sent by ***AtoMIC Pro*** are detailed in "Section 2 - Interface configuration guide" on page 33, except for SysEx message.

When the analogue toMIDI conversion uses this message, the digital value of the converted analog signal is sent via MIDI in the form of a System Exclusive message.

```
0xF0 ; Beginning of SysEx

0x00 ; SysEx ID
0x20
0x39

Atomic Pro ID (1-16)

0x78 ; SysEx function number (SysEx 10 message transmitted)

Analog input (1-32)

 Byte 1 ; 7 LSBs of the 10 bit value  }
 Byte 2 ; 3 LSBs of the 10 bit value  }   Value : MSBx128+LSB


0xF7 ; End of SysEx
```

Max objects and patches

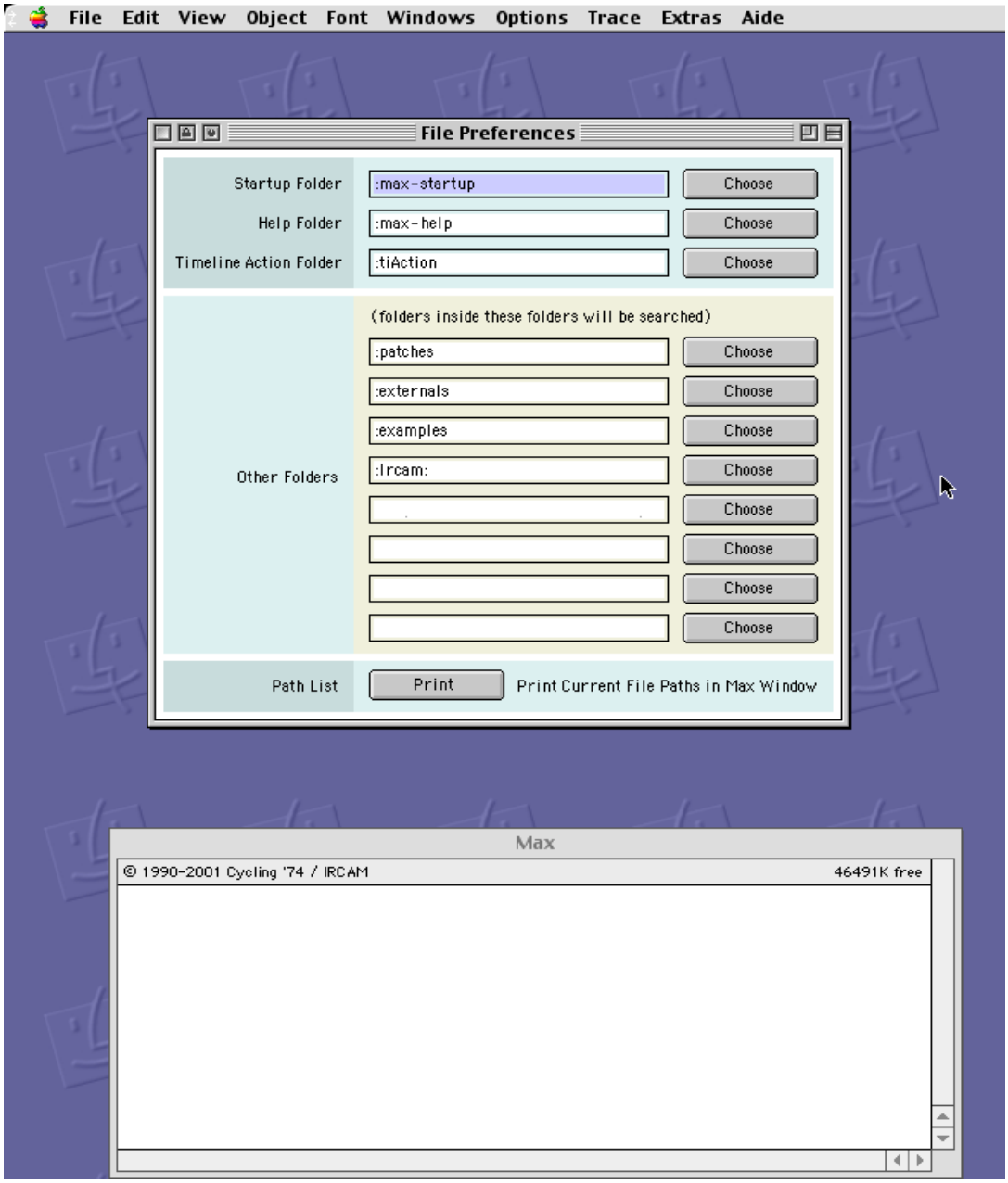
Some objects and patches have been developed specially for a piece of software called Max, to simplify the generation of MIDI System Exclusive messages which are to be used for configuration dumps and for the dynamic control of *AtoMIC Pro*.

If you don't own Max, the patches can be used with the MAXplay software included on the CD-ROM. MAXplay can also be downloaded from www.cycling74.com website.

Installation

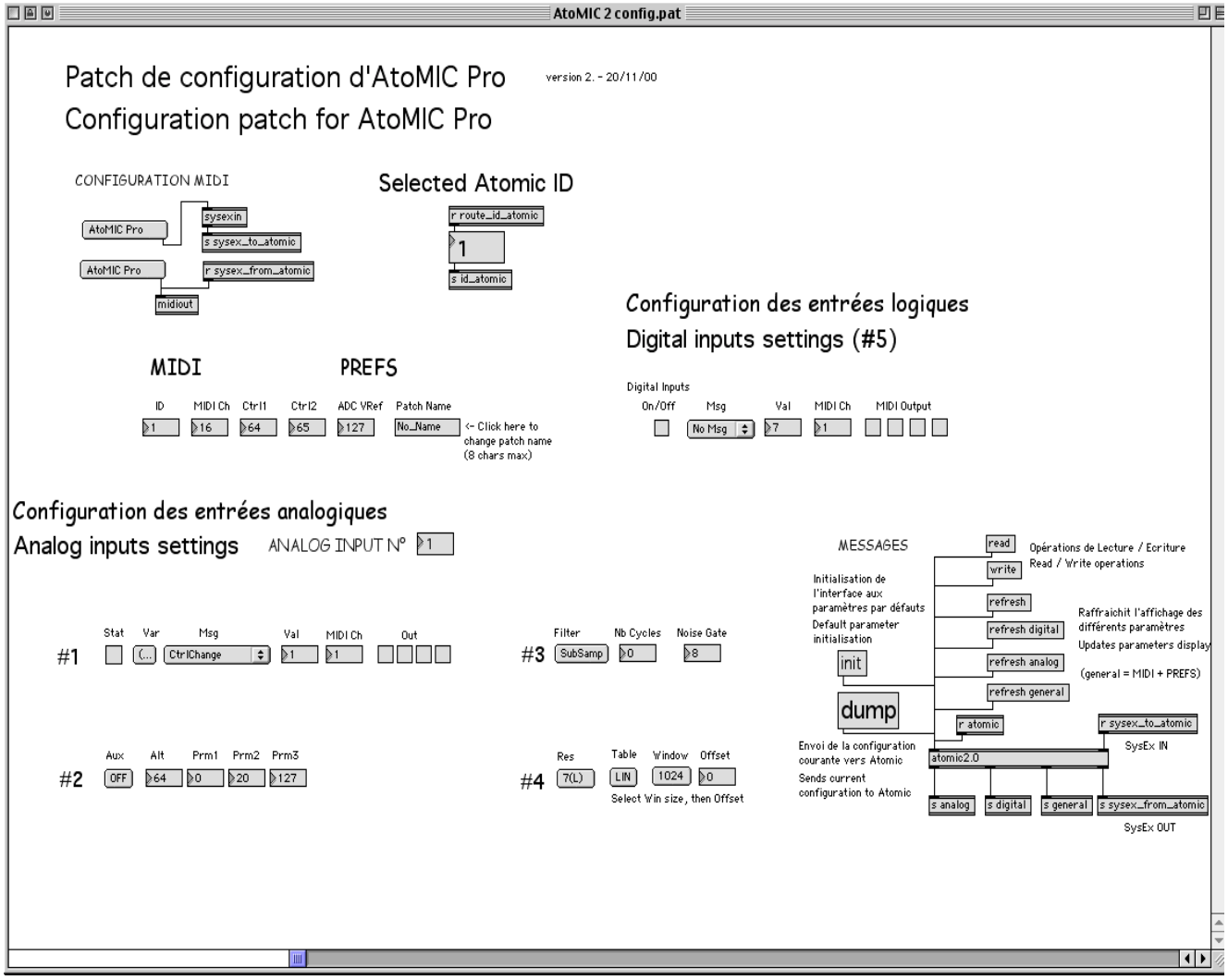
- Quit all running programmes.
- Copy the *Objets_AtoMIC_Pro* folder from the CD-ROM into the *External* folder in Max, or into another folder whose pathname is specified in Max. If this folder does not exist, create it before copying the *Objets_AtoMIC_Pro* folder into it.
- Copy the *AtoMIC_Pro_Help* folder from the CD-ROM into the Max folder entitled *MAX_Help*.
- Copy the *AtoMIC_Pro_Patches* folder from the CD-ROM into a folder of your choice.
- Check the OMS configuration, as well as the declaration of connected MIDI peripherals.

• Check that the *Objets_AtoMIC_Pro* folder is included in a folder whose pathname is in the paths which Max searches through. If this isn't the case, run Max and add a new search pathname (see illustrations below).



Max configuration patch for *AtoMIC Pro*

This patch allows the user to choose configuration parameters for the analog and digital inputs and to send them to ***AtoMIC Pro*** in the form of a dump using a MIDI *System Exclusive* message. This Max patch also enables the user to receive a configuration patch sent via a dump from ***AtoMIC Pro*** and to display it on the screen. This patch can be used also to load and save various configuration patches on the computer hard disk.



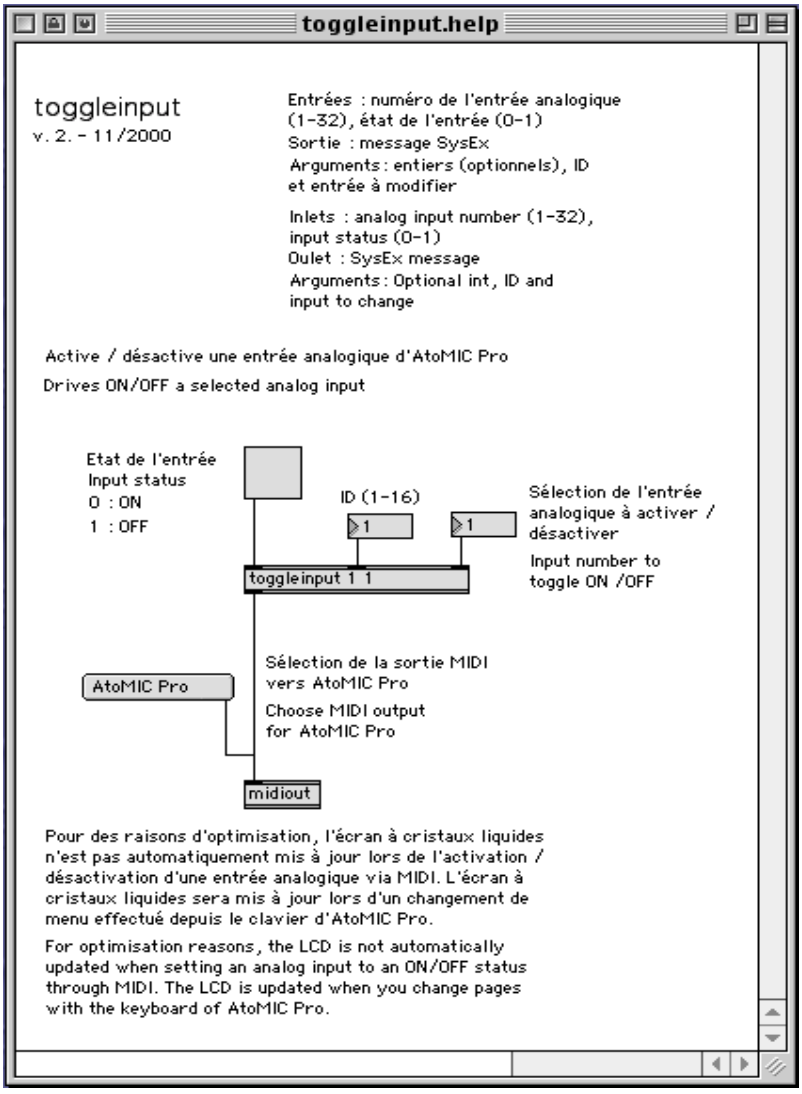
Dynamic controller patchers in *AtoMIC Pro*

These patchers generate MIDI *System Exclusive* messages allowing the dynamic control of certain parameters of ***AtoMIC Pro*** (for more details, refer to the paragraph entitled *Dynamic control of the **AtoMIC Pro** interface with System Exclusive messages*).

Do not hesitate to see the help patches for these patchers (click on the patcher in edit mode, and then press 'Command-*H*').

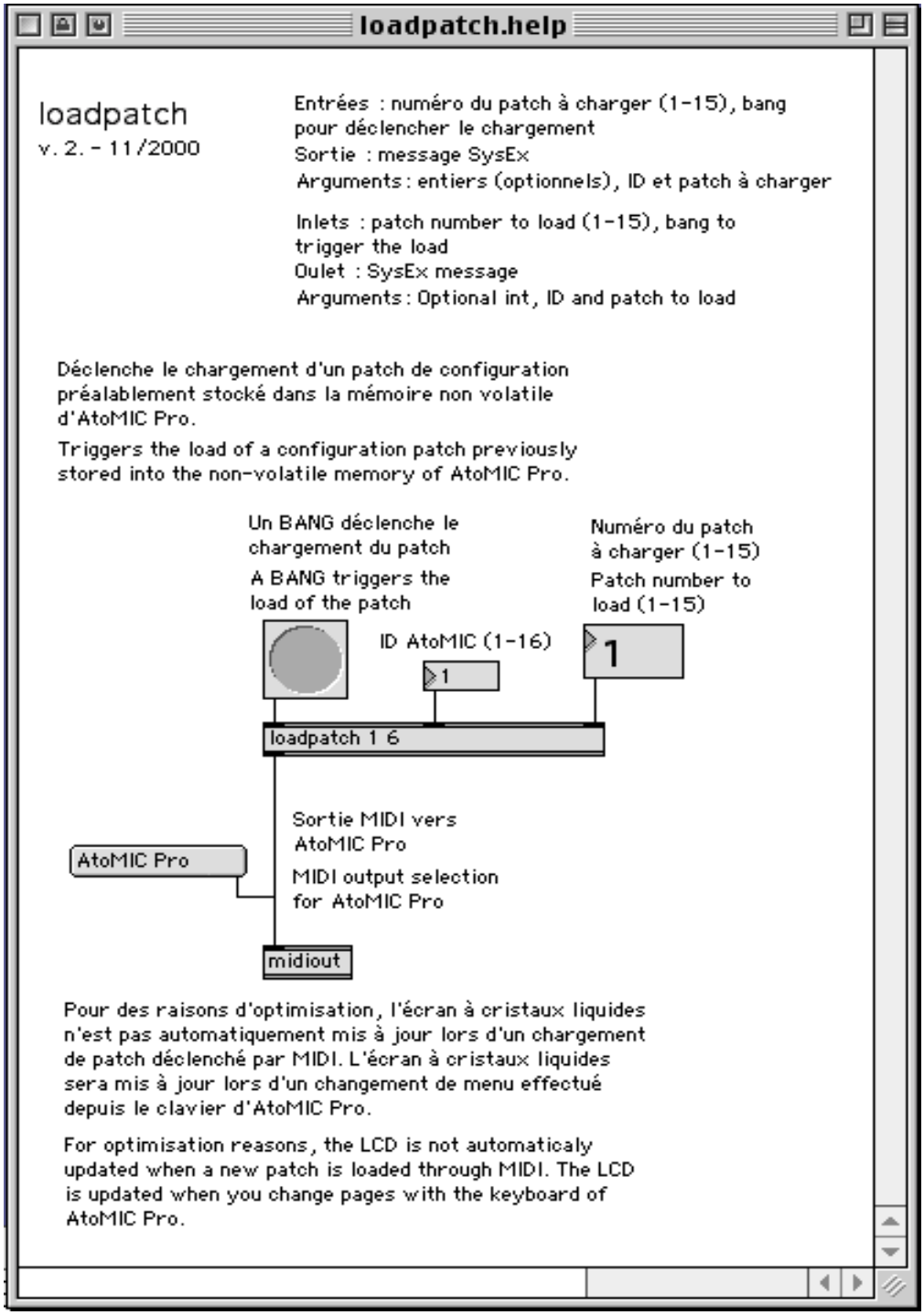
Activation / deactivation of an analog input

The status of each analog input (active or inactive) may be modified dynamically using the patcher called *toggleinput.*



Loading a configuration patch

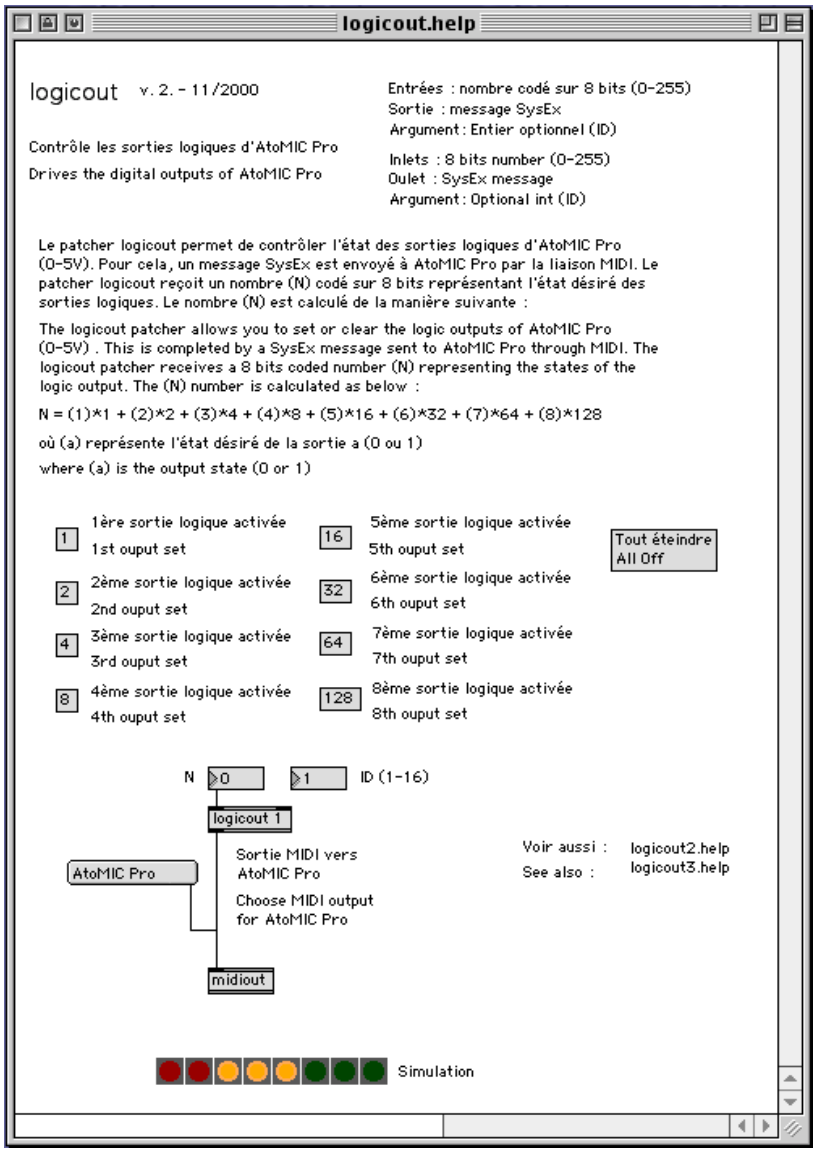
The load patch instruction is sent using the patcher called loadpatch.



Controlling the digital outputs

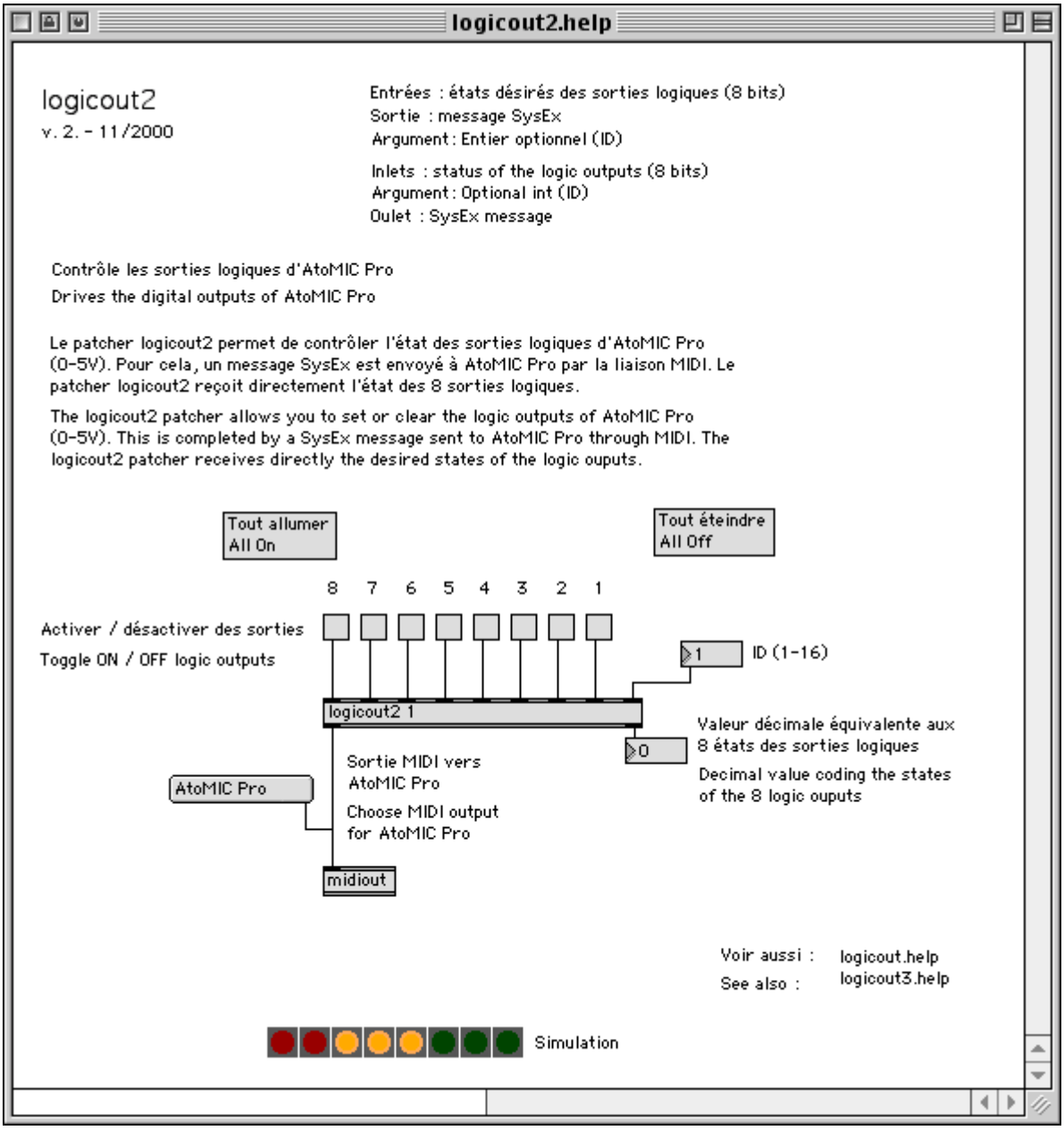
The status of the 8 digital outputs of ***AtoMIC Pro*** may be controlled by using MIDI *System Exclusive* messages generated by the patchers called *logicout* and *logicout2*.

→ **logicout**



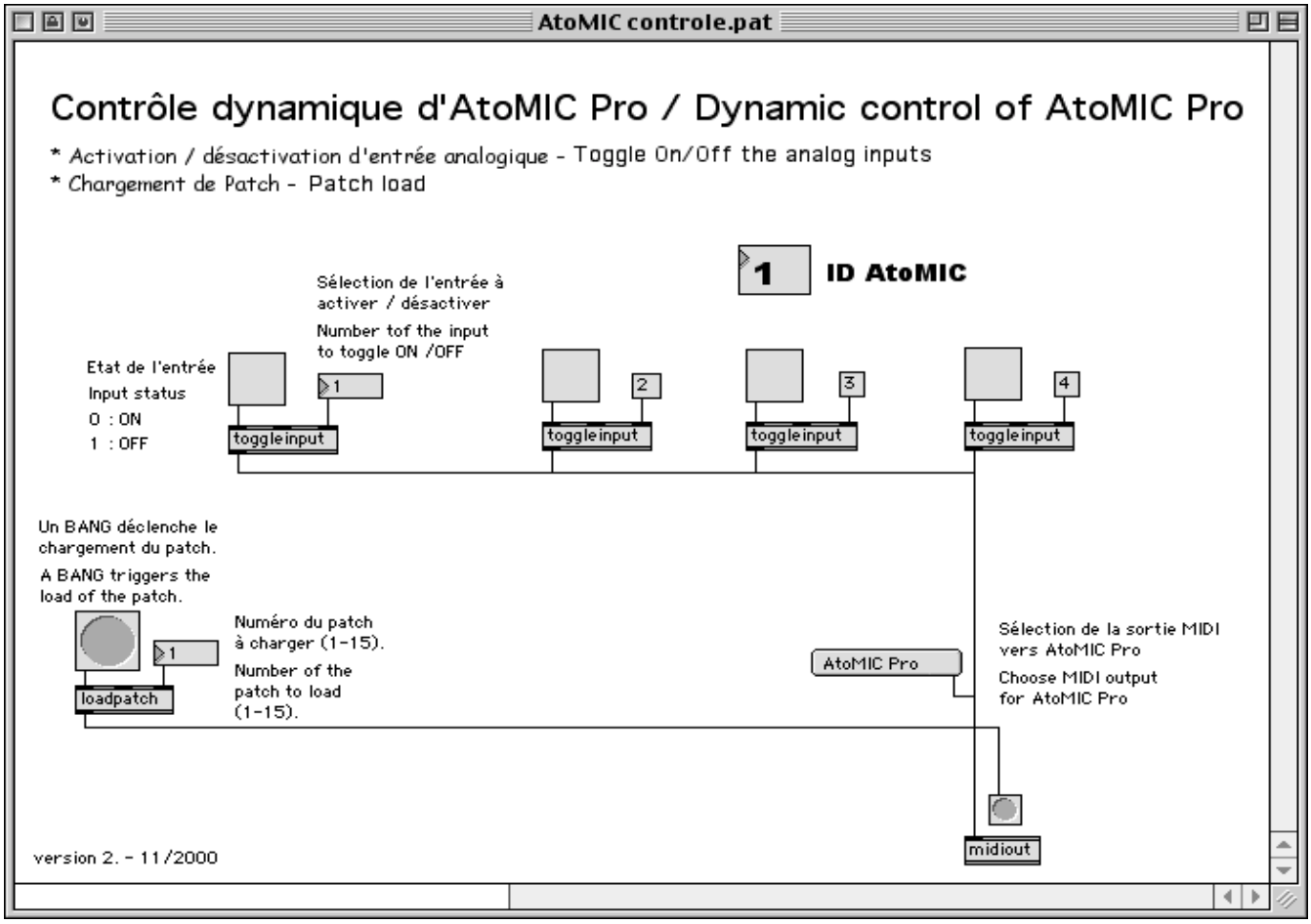
The status of the eight outputs is given directly to the *logicout* patcher in the form of a decimal number coded over eight bits. A bit which can take the values 0 or 1 is associated with each output. A weight represented as a power of two, multiplied by the state of the bit itself, is then associated with each bit.

logicout2



The patcher *logicout2* is identical to patcher *logicout*, except that the statuses of the outputs are explicitly given to the patcher, output by output.

Example of a Max patch for a dynamic control of *AtoMIC Pro*



In case of problems...

If the ***AtoMIC Pro*** interface does not function correctly, start by checking the following points. If the problem persists, please contact IRCAM.

The liquid crystal display does not show anything

Is the mains adapter plugged into the device?

Is the mains adapter plugged into a mains socket?

Has the Power ON light come on?

- Try plugging the mains adapter into another mains socket.
- If you are using a mains adapter which isn't the one which came with the device, make sure it is of the right polarity.
- The fuse of the device or of the mains adapter may be faulty. Refer to the section on *Replacing the fuse and the mains adapter.*

No MIDI OUT data (the *data out* light does not come on)

Are the analog signals correctly linked to the device?

- Check the analog input connections.

Are the relevant analog inputs active (Stat: ON) ?

- Check the status of the relevant inputs.

Are the signals visible on the vu-meters of the liquid crystal display?

- Check the threshold settings if you are using MIDI messages with thresholds.
- Turn the reference voltage down on the converter if necessary.
- Change the type of MIDI message used for the relevant analog inputs, and choose a *control change* message. This message will send messages which follow the changes in value of the analog inputs, and this should turn one or more *data out* lights on.

No MIDI OUT data (the *data out* light does come on)

Are the MIDI devices connected to ***AtoMIC Pro*** functioning correctly?

Are the MIDI cables plugged in correctly ?

- Check that the different devices work correctly, that the cables are plugged in correctly, and that they are not damaged.
- Is the right MIDI output selected with the `out` field ?

The digital outputs control does not work

Are the control messages reaching the MIDI IN input of the device?

- Check the MIDI connection between ***AtoMIC Pro*** and the device which should be sending the control messages for the digital outputs.

Do the control messages comply with the MIDI System Exclusive protocol of ***AtoMIC Pro***?

- Check the source of the System Exclusive messages.

Are the digital outputs correctly connected to the device(s) to be controlled?

- Check the wiring of the digital outputs.

Are the devices connected to the digital outputs consuming too much current ?

- Check how much current is being drawn by the devices connected to the digital outputs.

The generation of dump messages does not work

Is the device receiving the dump function correctly ?

- Check the MIDI connections.
- Try different MIDI cables.

The reception of dump messages does not work

Does the device sending the dump function correctly ?

Does the device sending the dump conform to the MIDI System Exclusive protocol of ***AtoMIC Pro*** ?

Is the device sending the dump connected to the MIDI IN input of ***AtoMIC Pro*** ?

Is the ***AtoMIC Pro*** ID number correctly set in ?

- Check the “MIDI” preferences in the main menu.
- Check the System Exclusive compatibility.
- Check the MIDI connections.
- Try different MIDI cables.

Replacing the fuse and the mains adapter

WARNING :

Make sure the mains adapter isn't plugged into the device, and that the device isn't powered up before you follow the instructions given bellow.

Replacing the fuse

If the power on light of the ***AtoMIC Pro*** interface does not light up, and the mains adapter works correctly, you should change the fuse which may be faulty.

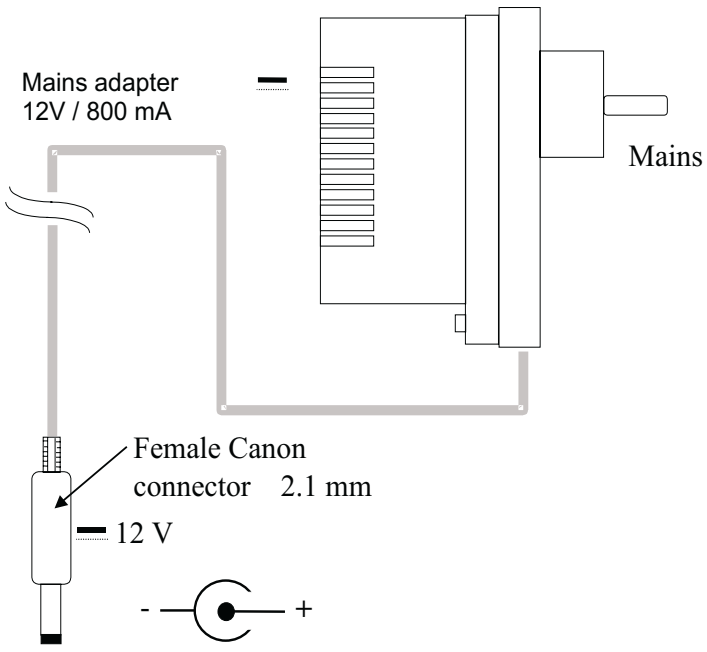
Unscrew the 4 screws from the bottom of the device using a Phillips screwdriver. Gently take the top lid off the device, and put it down. The fuse sits in a holder situated in the top left-hand corner of the liquid crystal display, on the lower plate. The fuse is of the 250 V, 1 Amp, temporised blow type.

Take the fuse out using a small screwdriver and replace it with a new fuse. Put the lid back into place as well as the 4 screws and then power up the device to ensure it is working properly.

Replacing the mains adapter

The mains adapter supplied with ***AtoMIC Pro*** is designed for use with the French mains supply which functions at 230 V alternating / 50 Hz. If your mains supply is not compatible with these specifications, you should replace the mains adapter. The *output* voltage of the mains adapter should be a *constant* 12 Volts (DC or the symbol ⎓). The power connector to be plugged into the back of ***AtoMIC Pro*** is a female *Canon* connector. The internal diameter of the connector is 2.1 mm.

The mains adapter must be capable of giving an output current of 800 mA.



Restoring factory settings (initialisation)

If you would like to restore the default configuration patches of ***AtoMIC Pro***, follow the following procedure.

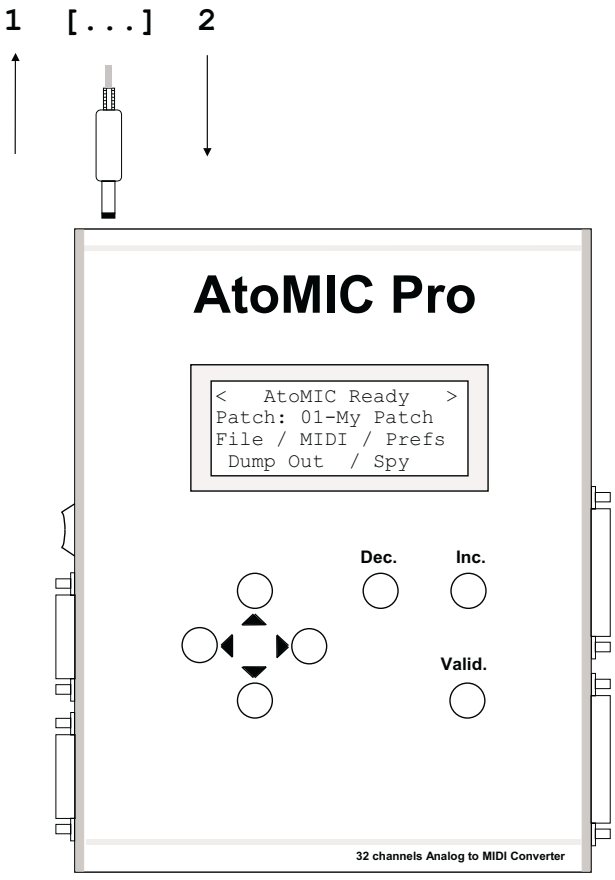
→ **WARNING :**

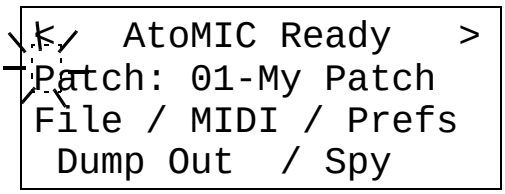
Restoring the factory settings will cause the loss of the configuration patches saved in the non-volatile memory of the device. It is advised that you save these patches onto a sequencer or a MIDI recording device (refer to the paragraphs entitled *Sending / Receiving dump messages* as well as *Max objects and patches*).

Instructions

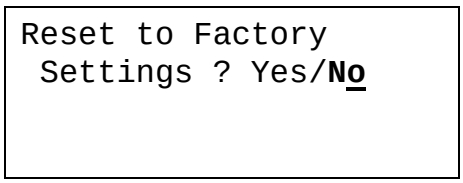
1. Unplug the power connector from the device and wait until it is completely turned off.

2. Plug the power connector back in, and keep the ***Inc***. and ***Dec***. keys pressed. After the start-up screen has been displayed, the restore screen for the factory settings comes up.



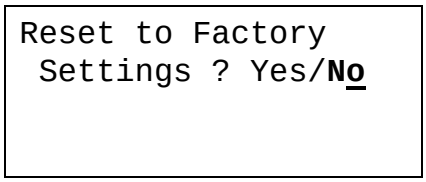


[...]

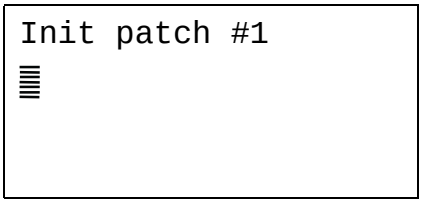


You may cancel the operation of restoring the factory settings by validating the **No** field, using the *Valid* key.

3. To go ahead with restoring the factory settings, move the flashing cursor onto the **Yes** field using the arrow keys and then press the *Valid* key.



[*Valid.*]



The process of restoring the factory settings lasts about 40 seconds. During that time, a mini vertical bar graph will count down 15 times (once per restored patch). When the parameters has been restored, the ***AtoMIC Pro*** interface displays the welcome menu. Make sure not to disconnect the power supply from the device during the operation. If this happens, repeat steps 1 to 3.

Factory settings

General

- Name of the patch : "No Name"
- Contrast of the liquid crystal display: 8 (Ctrst: 8)
- Reference voltage of the analog to digital converter: +5V (ADC Vref: 127)

MIDI preferences

- Device ID : 1 (ID:1)
- Receive MIDI channel : 16 (MIDI Ch: 16)
- Program number : 1 to 15, for patches 1 to 15 (Program Nb: 1 to 15)
- LSB Digital outputs controller number : 64 (Ctrl1: 64)
- MSB Digital outputs controller number : 65 (Ctrl2: 65)

Analog inputs 1 to 32

- Analog input: inactive (Stat: OFF)
- Direction of variation: positive (Var: +)
- MIDI message: control change (Msg: C-Chg)
- Note number / Controller number: 1 to 32 (Val: 1 to 32)
- MIDI channel: 1 (MIDI Ch: 1)
- Physical output: 1 (Out: xxxO)
- Control by a digital input: inactive (Aux: OFF)
- Alternative value: 64 (Alt: 64)
- Multipurpose parameter 1 : 0 (Prm1: 0)
- Multipurpose parameter 2 : 20 (Prm2: 20)
- Multipurpose parameter 3 : 127 (Prm3: 127)
- Noise gate threshold : 8 (Noise gate: 8)
- Data filtering : subsampling (Filter: SUBSAMP
- Filter iteration number : 0 (Nb cycles: 0)
- Resolution : 7 bit MIDI (Res:7 (L))
- Lookup table : Linear (Table: LIN)
- Window size : 1024 (Window: 1024)
- Window offset : 0 (Offset: 0)

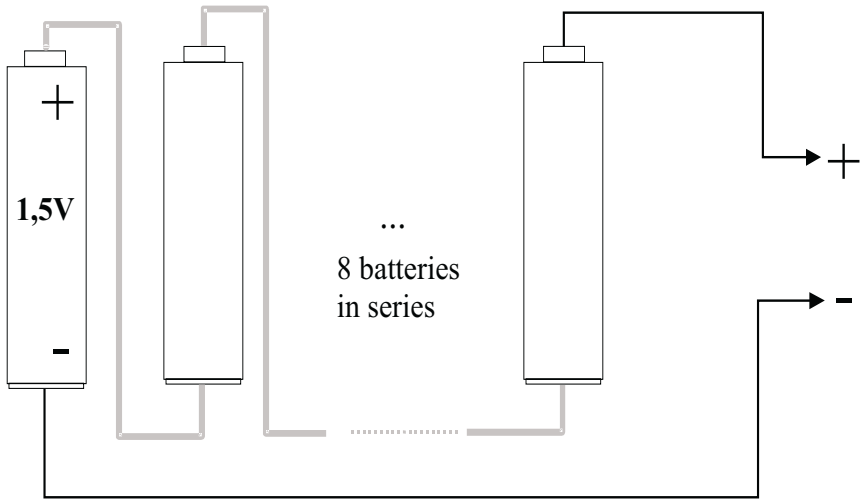
Digital inputs

- Digital inputs: inactive (Digital inputs:OFF)
- MIDI message: no message (Msg:No Msg)
- Note number / Controller number: 0 (Val:0)
- MIDI channel: 1 (MIDI Ch:1)
- Physical output: 1 (Out: xxxO)

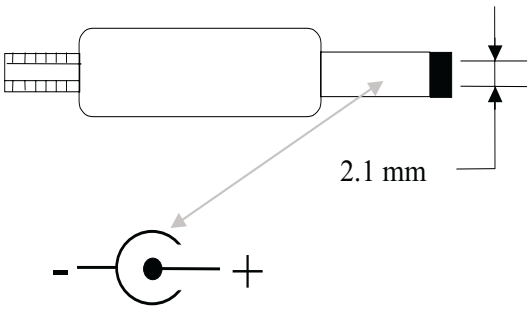
Powering with batteries

AtoMIC Pro is designed to work with a minimum voltage of 12 volts DC for 200 mA (excluding the backlite of the liquid crystal display). However, ***AtoMIC Pro*** can function on 9 volts, but will draw a current of 300 mA.

This voltage can be obtained with a 9V battery (reference PP3), which doesn't have much charge (500 mAh). In order to extend the time available when powering with batteries, the best solution is to use eight 1.5V batteries wired in series[12]. To do this, use one or two battery holders (1 x 8 or 2 x 4 batteries).



Wire the batteries to ***AtoMIC Pro*** using a *Canon* type power plug with an internal diameter of 2.1 mm.



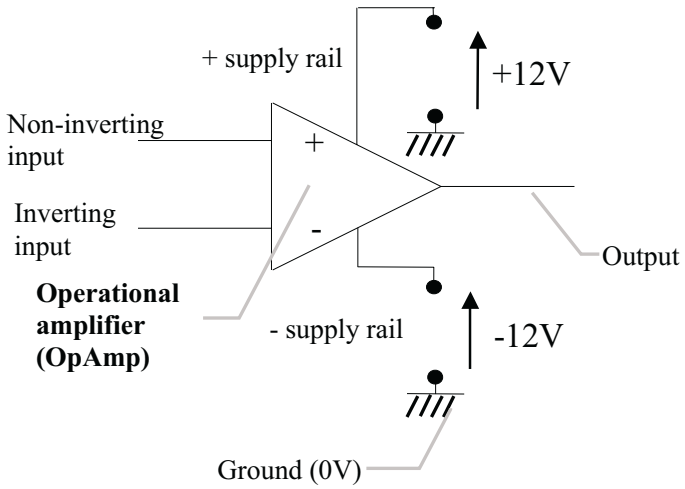
→ **NOTE :**

Given the extra current consumption of the backlite for the liquid crystal display, you are advised not to use the backlite when using the device on batteries in order to prolong their charge.

12. AAA/R3, AA/R6, C/R14 or D/R20 depending on the required charge.

Amplifying analog voltages

This paragraph shows only a few design examples for preconditioning analog signals in order to obtain signals with a high enough level. Amplification of the analog signals often uses electronic components called operational amplifiers. Very cheap and available in the form of integrated circuits, they have the advantage of being able to multiply analog signals by a factor of 100,000 and sometimes more. Of course, a signal on the output of an operational amplify can not exceed the supply voltage.

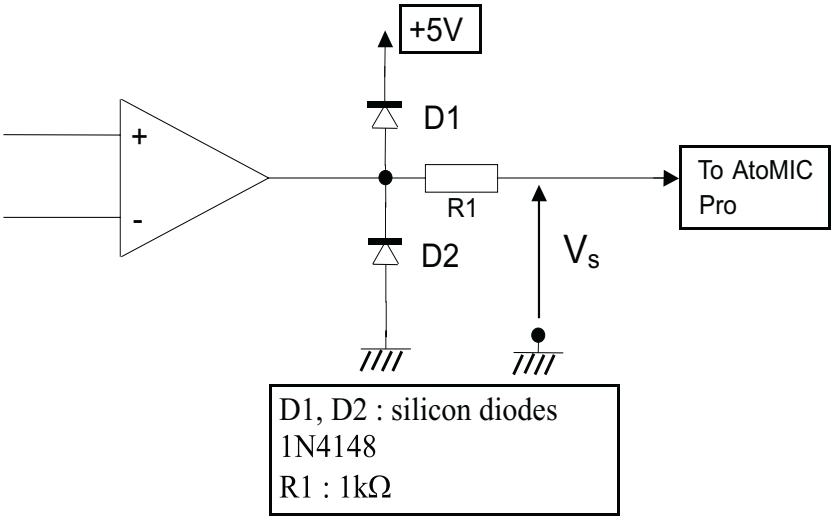


Operational amplifiers usually work with symmetrical power rails (± 12 volts, for example). ***AtoMIC Pro*** exports these supply voltages onto the analog input connectors[13] which greatly facilitates the use of conditioning modules external to *AtoMIC Pro.*

→ **WARNING :**

Operational amplifiers are often powered using high positive AND negative voltages. The amplified signals can easily reach values above 5 volts (absolute value). ***AtoMIC Pro*** can only take voltages which are positive and smaller than or equal to 5 volts. Any negative voltage or any voltage above 5V can damage the device.

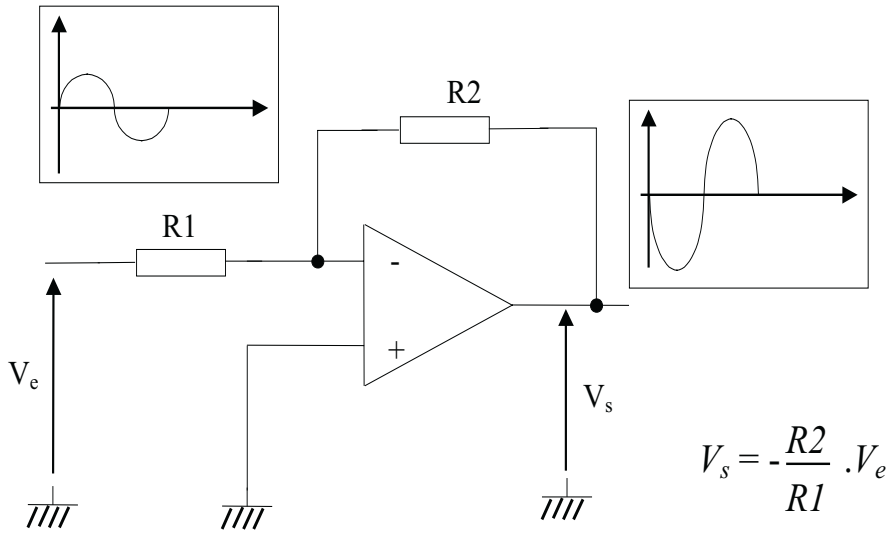
13. For a maximum current of 80 mA. Refer to section 1 (Introduction) for more details on exporting the supply voltages.



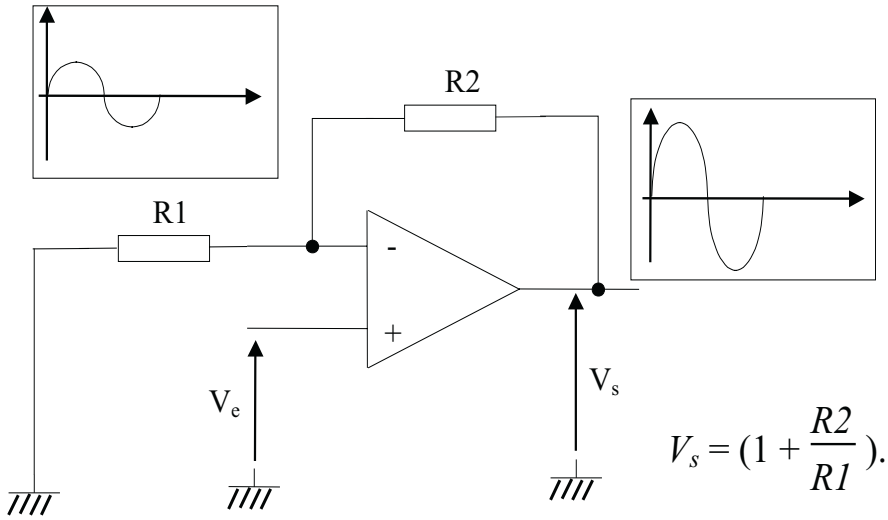
This circuit uses two diodes which conduct when the output signal from the operational amplifier reaches 5.7 volts or -0,7 volts approximately. The level of the analog signal on the inputs of ***AtoMIC Pro*** cannot therefore exceed greatly the maximum and minimum levels specified (5 and 0 volts). You are advised to integrate this protection at each stage of signal conditioning which is connected before ***AtoMIC Pro***.

Design examples for amplifying analog voltages

Inverting amplifier

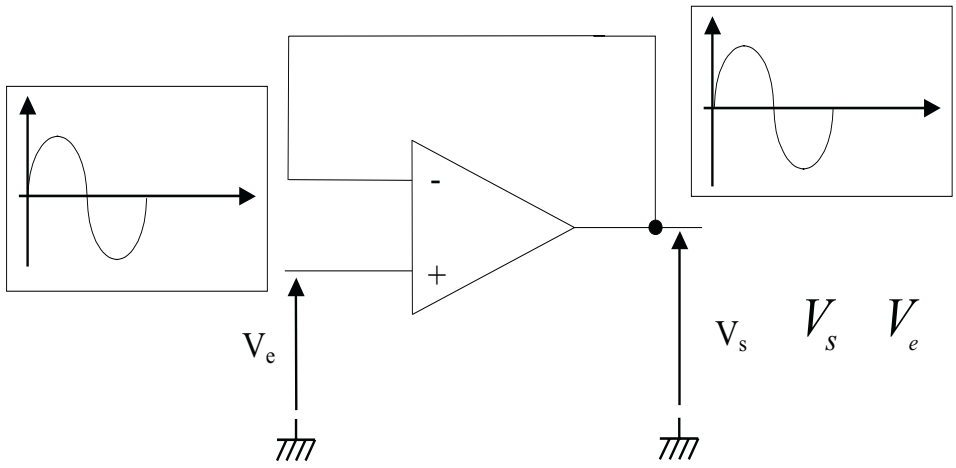


Non-inverting amplifier



$$V_s = (1 + \frac{R2}{R1}).V_e$$

Non-inverting amplifier with unity gain (buffer / impedance adapter)

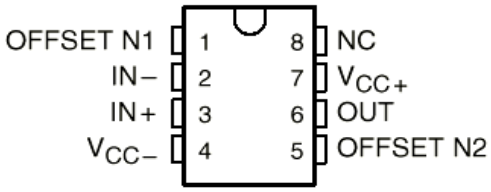


$V_s \quad V_e$

Operational amplifier references (FET Opamps, for general use)

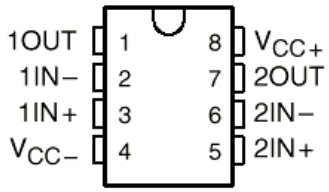
TL081 (single amplifier with ajustable offset)

TL081, TL081A, TL081B
D, JG, P, OR PW PACKAGE
(TOP VIEW)



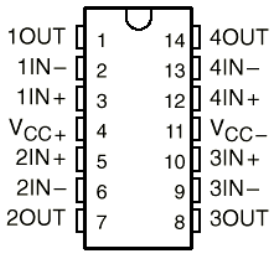
TL082 (double amplifier)

TL082, TL082A, TL082B
D, JG, P, OR PW PACKAGE
(TOP VIEW)



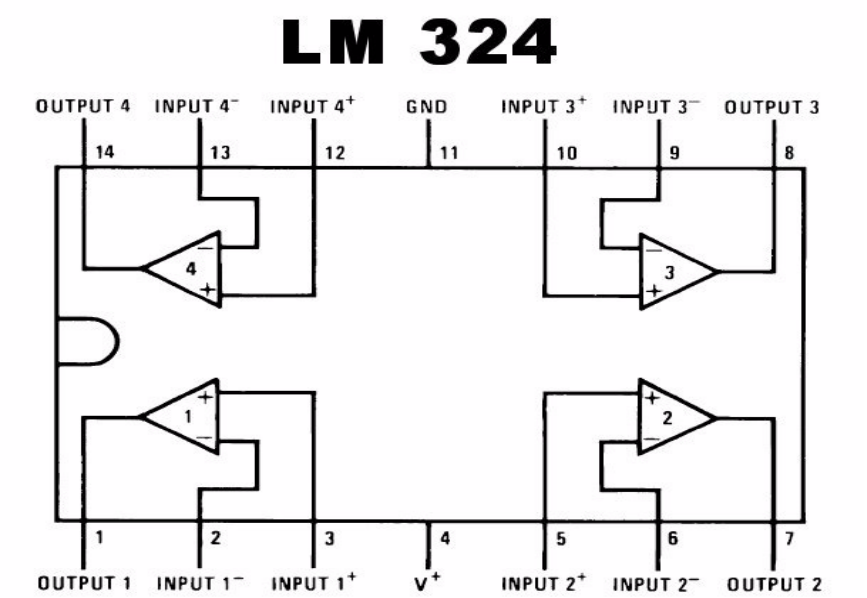
TL084 (quadruple amplifier)

TL084, TL084A, TL084B
D, J, N, PW, OR W PACKAGE
(TOP VIEW)

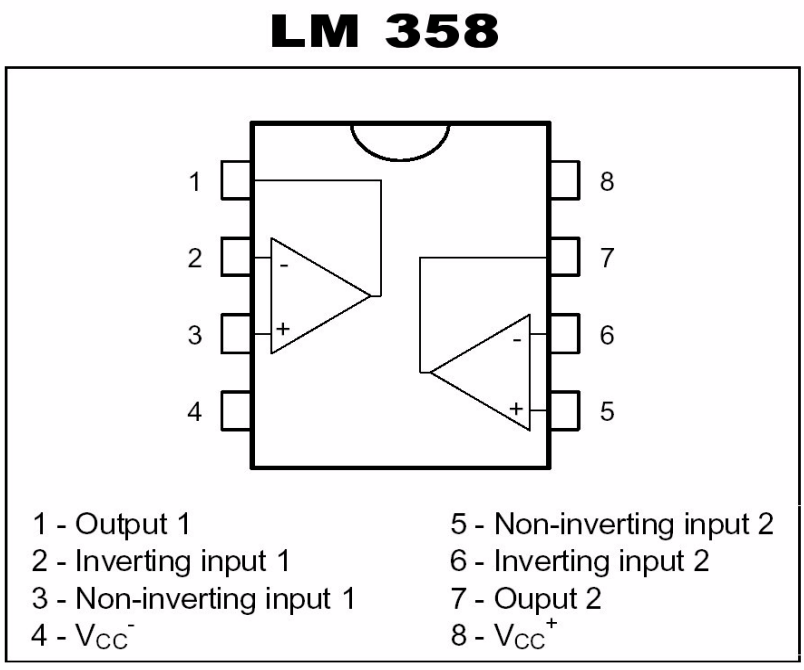


NC – No internal connection

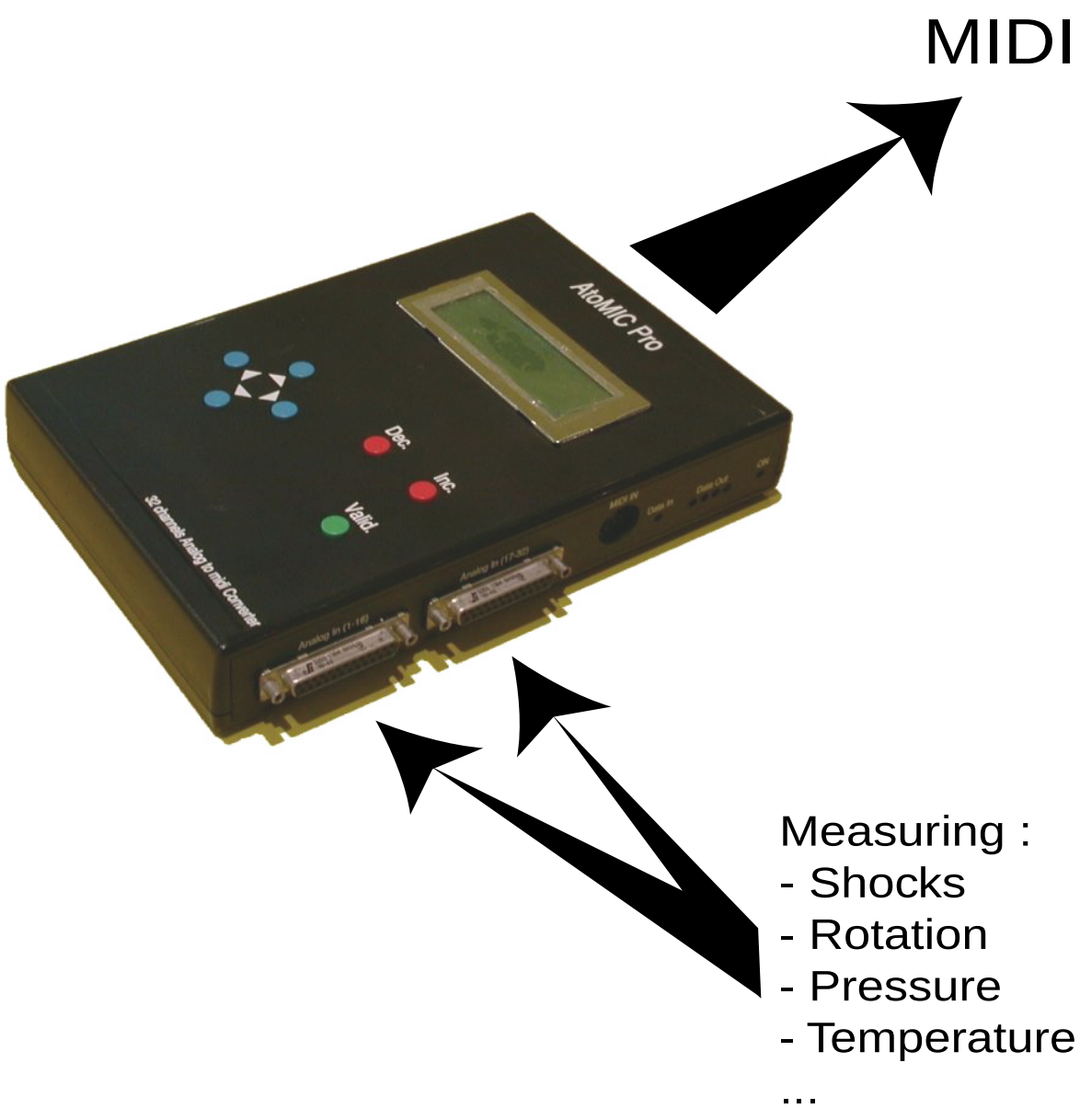
LM324 (single supply voltage)



LM358 (single supply voltage)



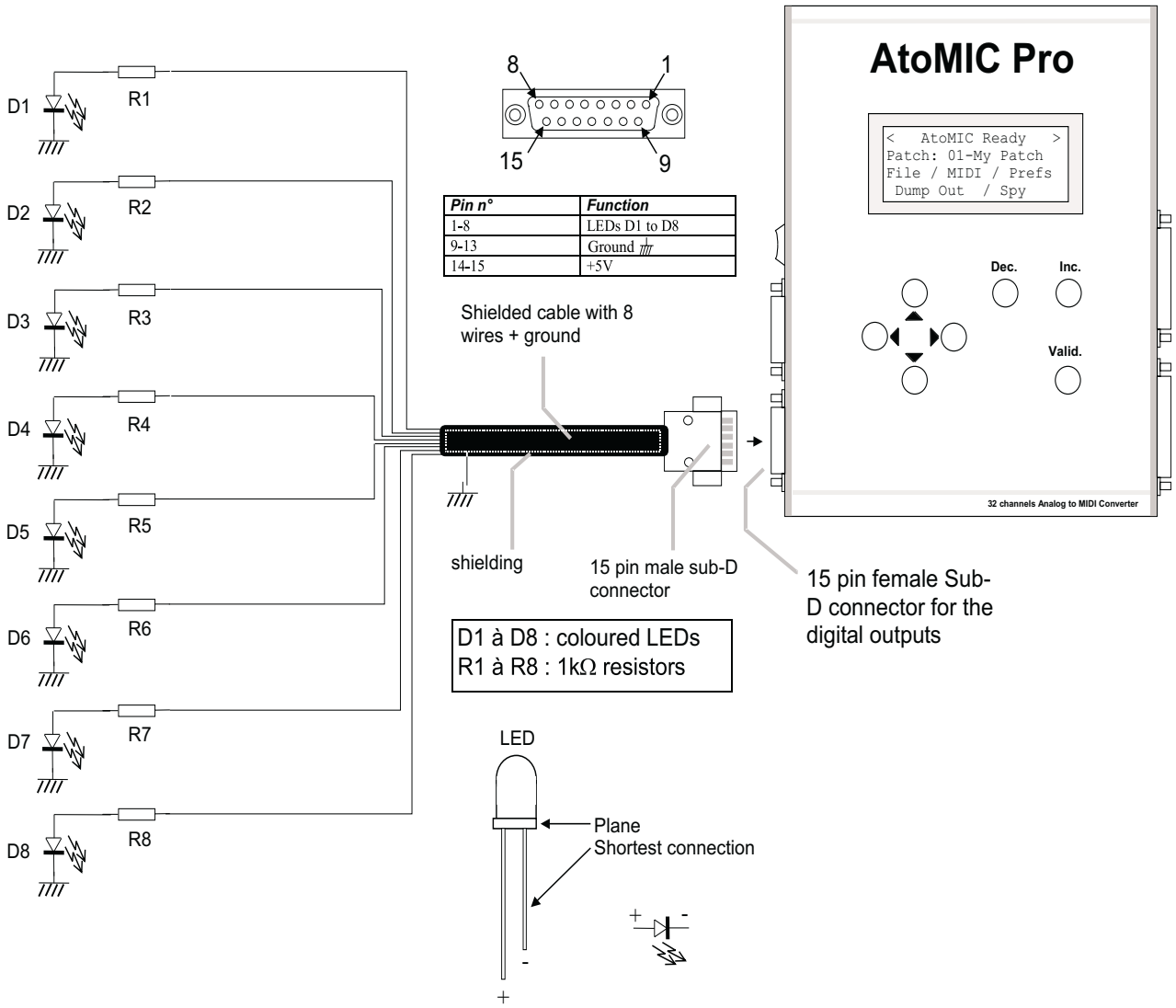
Design examples



Running lights controlled by MIDI

Running lights are made of a series of LEDs[14] which switch on and off in turn. The aim here is to control 8 coloured LEDs with MIDI, using Max patches.

Wiring diagram



14. Light Emitting Diode

→ NOTE :

It is not necessary to have Max to implement running lights. Any MIDI device may be used which is capable of generating MIDI System Exclusive messages compatible with the ***AtoMIC Pro*** protocol.

→ Instructions :

Connect ***AtoMIC Pro*** up to the circuit shown previously (wire the 15 pin male Sub-D connector to **the 15 pin female Sub-D 15 connector for the digital outputs**).

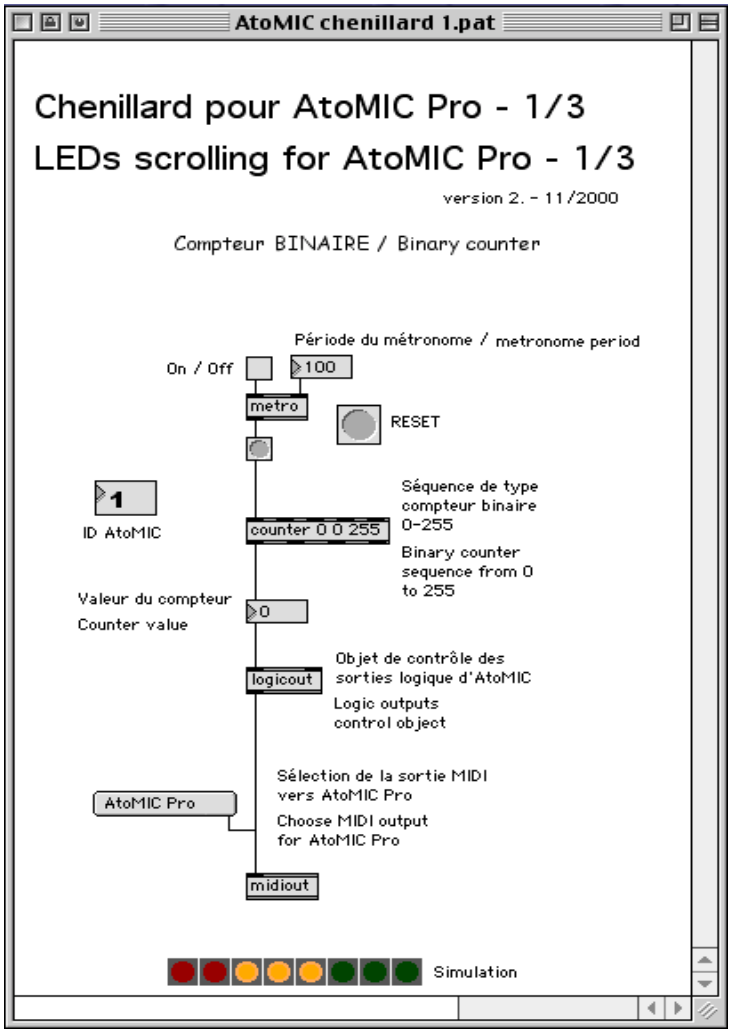
Connect the MIDI IN input of ***AtoMIC Pro*** up to the MIDI OUT output of the MIDI interface of the Macintosh on which Max is running.

Power up ***AtoMIC Pro***. The LEDs should light up briefly while the device starts up.

Load the *'AtoMIC Chenillard 1.pat'* Max patch. [Note: *Chenillard (French)* means running lights]

Select the MIDI output connected to ***AtoMIC Pro*** from the outputs available in OMS. If you are not using OMS, edit the patch, delete the objects relative to OMS and indicate the name of the MIDI port in the *midiout* object (in general, the MIDI ports are called *a* or *b*)

Activate the metronome: the LEDs in your circuit, as well as the simulation LEDs (i.e. in the Max patch) should light up in sequence.

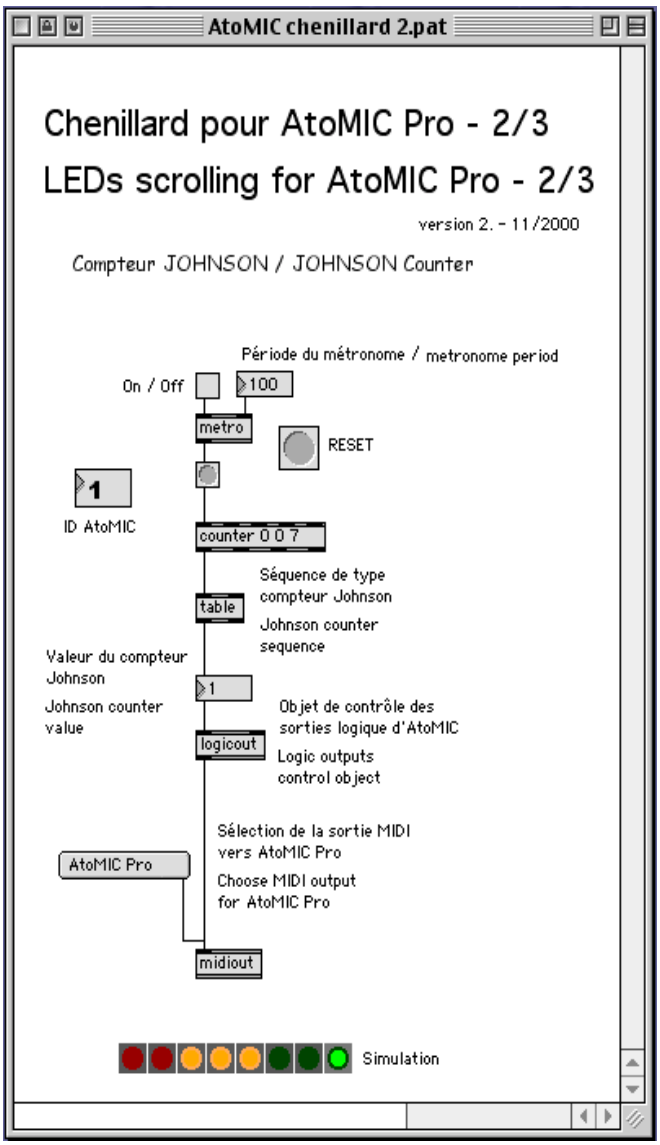


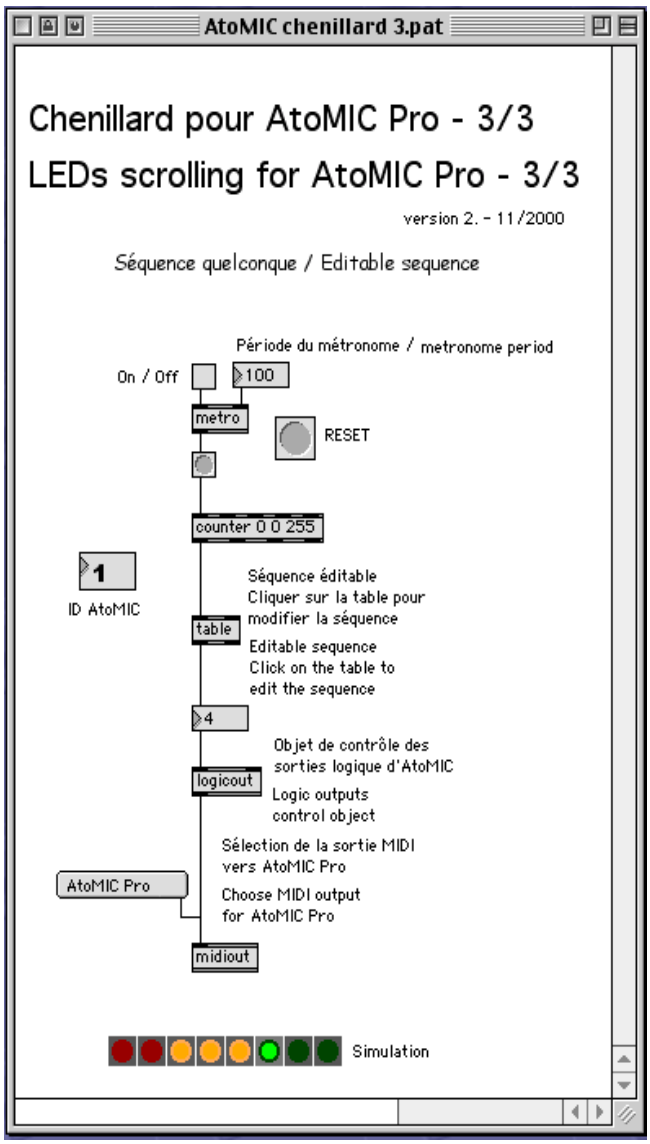
The *'AtoMIC Chenillard 1.pat'* patch is a running light command in the form of a binary counter. The decimal number coming from the *counter* object is sent directly to ***AtoMIC Pro*** using the *logicout* object. The conversion of the decimal number into binary is done inside ***AtoMIC Pro*** and this is then sent to the 8 LEDs.

Two other Max patches can be used to implement different running lights:

'AtoMIC Chenillard 2.pat': Johnson counter. The eight LEDs light up one after the other, only one LED ever being lit at any given time.

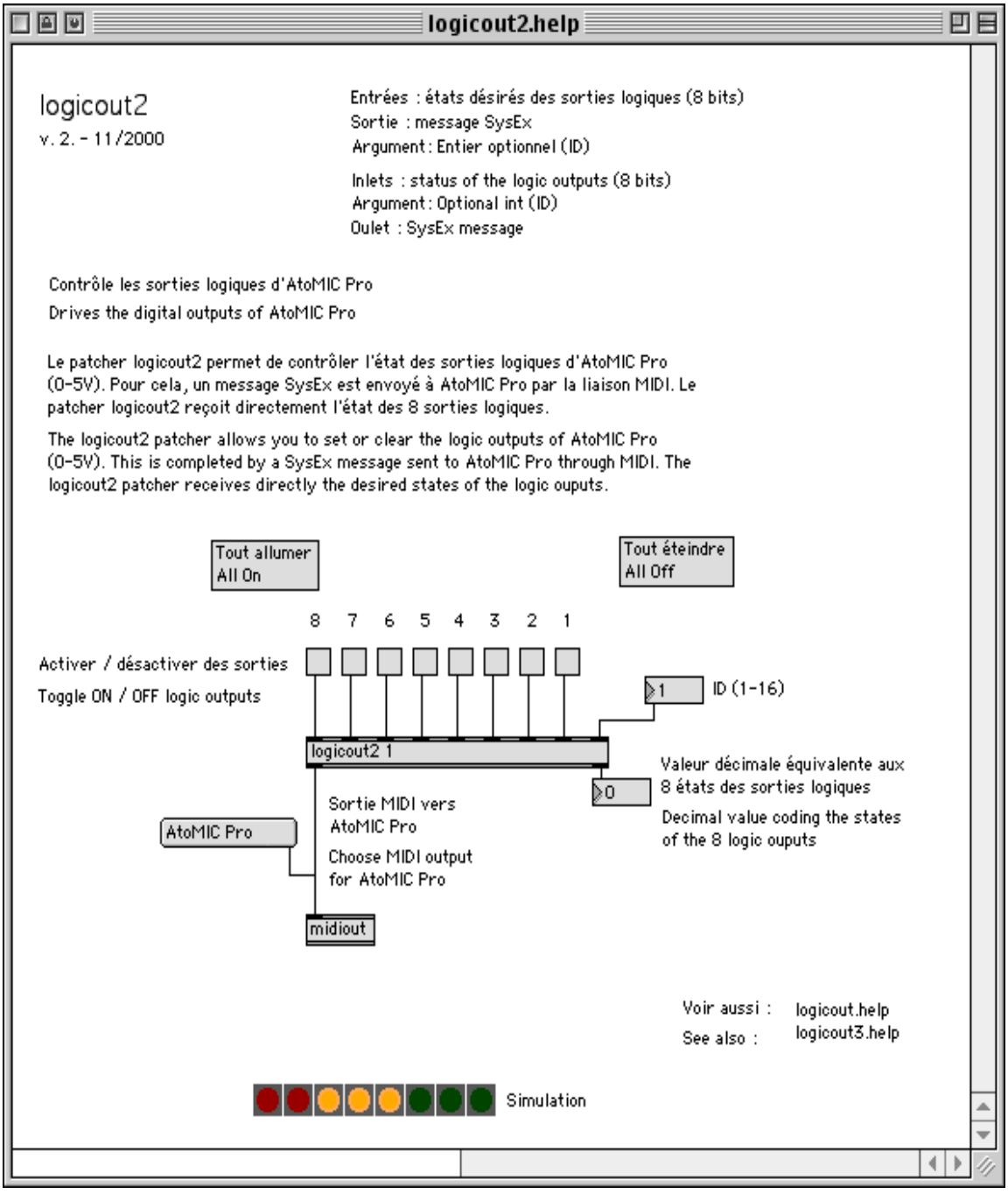
'AtoMIC Chenillard 3.pat': in this patch, the lighting sequence of 256 iterations can be edited. This is done by graphically editing a *table* object, which stores the sequence to change its aspect.


AtoMIC chenillard 2.pat
Chenillard pour AtoMIC Pro - 2/3
LEDs scrolling for AtoMIC Pro - 2/3
version 2. - 11/2000
Compteur JOHNSON / JOHNSON Counter
Période du métronome / metronome period
On / Off
100
metro
RESET
1
ID AtoMIC
counter 0 0 7
Séquence de type compteur Johnson
table
Johnson counter sequence
Valeur du compteur Johnson
Johnson counter value
1
Objet de contrôle des sorties logique d'AtoMIC
logicout
Logic outputs control object
Sélection de la sortie MIDI vers AtoMIC Pro
AtoMIC Pro
Choose MIDI output for AtoMIC Pro
midiout
Simulation


AtoMIC chenillard 3.pat
Chenillard pour AtoMIC Pro - 3/3
LEDs scrolling for AtoMIC Pro - 3/3
version 2. - 11/2000
Séquence quelconque / Editable sequence
Période du métronome / metronome period
On / Off
100
metro
RESET
counter 0 0 255
1
ID AtoMIC
Séquence éditable
Cliquer sur la table pour modifier la séquence
table
Editable sequence
Click on the table to edit the sequence
4
Objet de contrôle des sorties logique d'AtoMIC
logicout
Logic outputs control object
Sélection de la sortie MIDI vers AtoMIC Pro
AtoMIC Pro
Choose MIDI output for AtoMIC Pro
midiout
Simulation

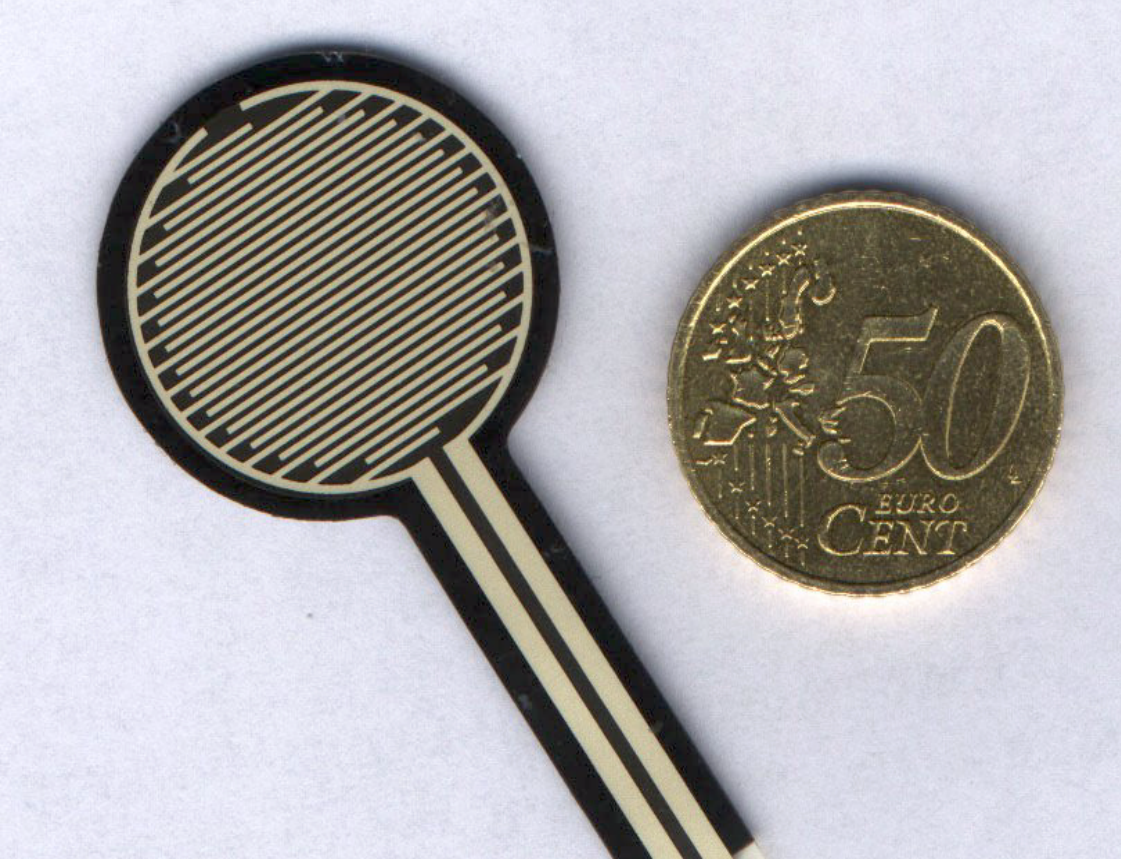
Independent control, LED by LED

If you would like to control each LED separately, consult the help patch of the *logicout2* patcher which enables the control of the digital outputs, bit by bit.

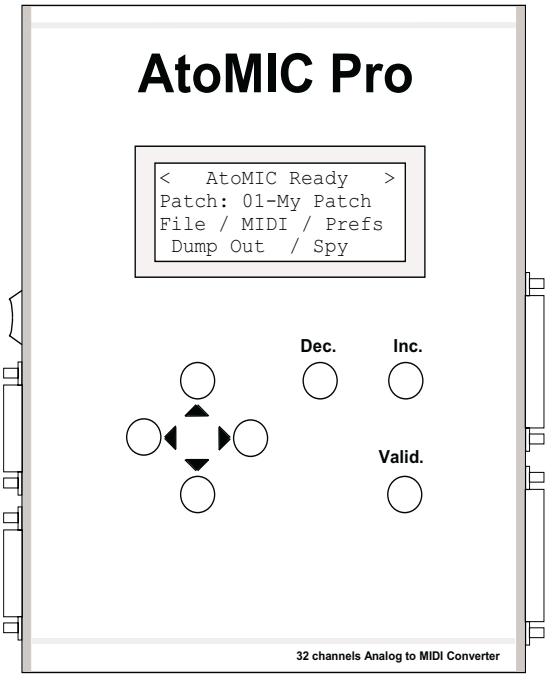


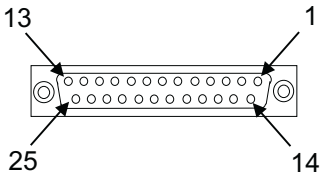
Using an FSR pressure sensor

An FSR (Force Sensitive Resistance) sensor measures the mechanical pressure applied to its surface. It comes in the form of a sensitive disk, of variable size depending in the model. The sensor is made of a material whose electrical resistance (ohmic resistance) goes down when the pressure on the sensor goes up. By wiring this sensor into a potential divider form, a continuous analogue signal can be obtained which is proportional to the pressure applied to the sensor. This signal can be used, for example, to change the value of a MIDI controller in real time, by applying pressure onto the sensor. It can also be used to generate MIDI notes when a finger is used to hit the sensor.

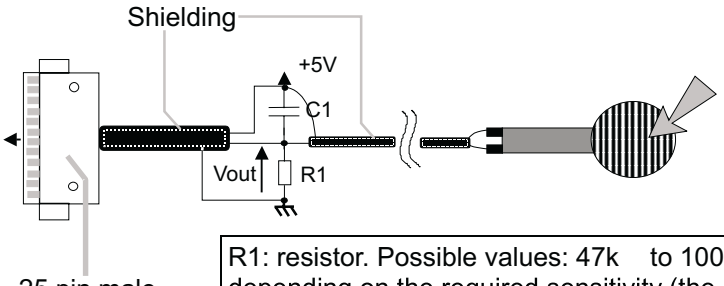


Wiring diagram:





Pin n°	*Function*
1-16	Analog inputs 1 to 16 (17 to 32 on the second connector)
17	Not connected
18-21	Ground
22-23	+5V
24	+12V
25	-12V



25 pin male Sub-D connector

R1: resistor. Possible values: 47k to 100k depending on the required sensitivity (the higher the resistance, the higher the sensitivity to pressure).
C1 : plastic capacitor 220 nF

The user may choose which analog input to use. The user can choose also to connect the FSR sensor onto one of the inputs 17 to 32. All that needs to be done is to plug the 25 pin male Sub-D connector onto the second female Sub-D connector of the analog inputs.

→ **NOTE :**

The potential divider shown above is not perfect, since the resistance of the sensor cannot go below 1kΩ. The output voltage of this configuration can therefore never reach 5 volts. To counterbalance this effect, the reference voltage of the Analog-to-Digital Converter may be turned down (*Prefs* menu, `ADC Vref` field) to maximise its resolution.

Reference

FSR sensor

Manufacturer: International Electronic & Engineering

FSR models : FSR 149, FSR 150, FSR 151, FSR 174

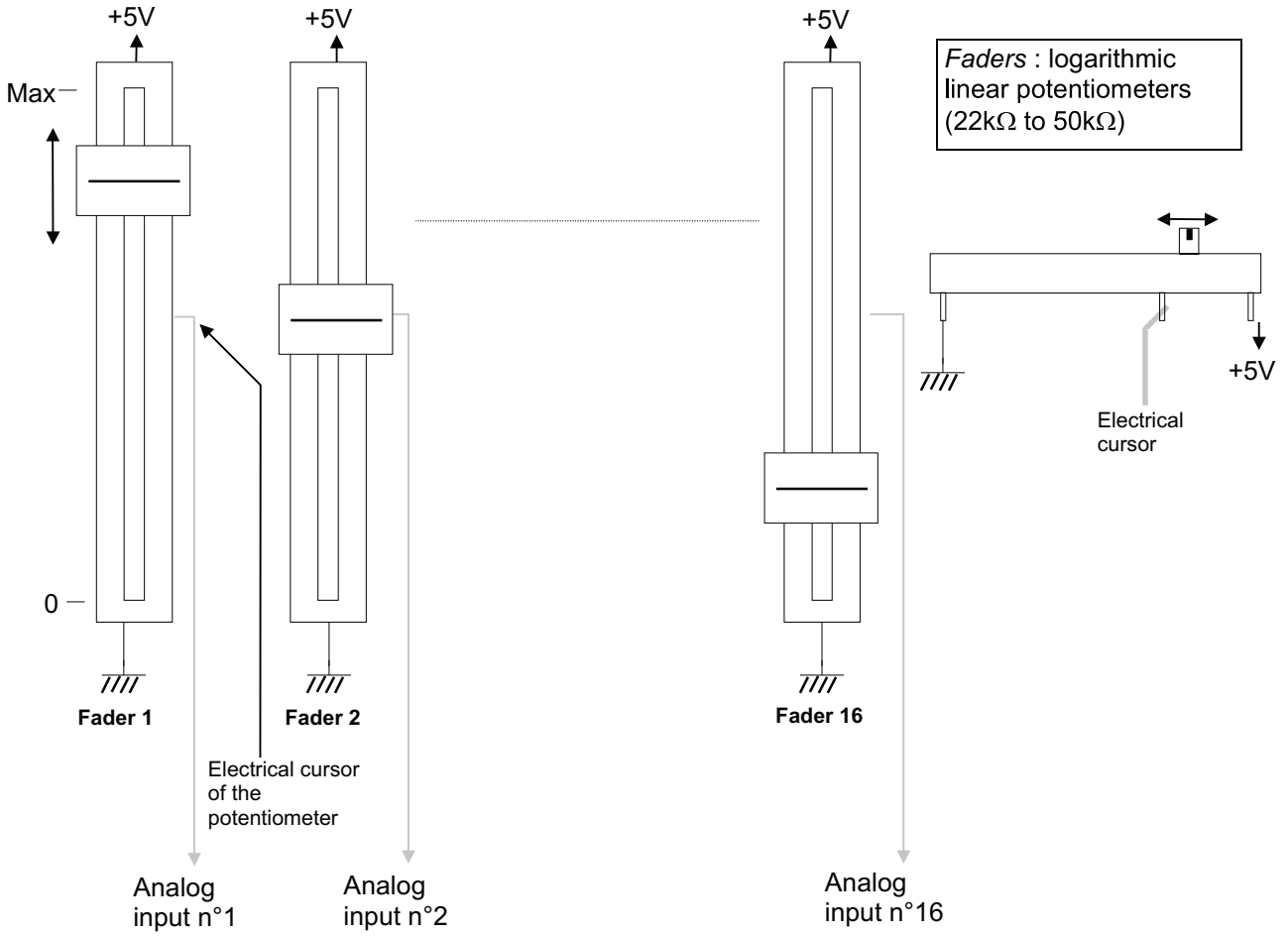
Manufacturer's website: `http://www.iee.lu/`

MIDI "mixing desk"

The idea is to use a group of 16 linear potentiometers to control the level of 16 MIDI channels. These potentiometers are identical to the ones used on the channels of an audio mixing desk[15]. The 16 analog signals (between 0 and 5 volts) from the potentiometers are converted into MIDI volume controllers (controller number 7) on each of the 16 MIDI channels.

15. Linear potentiometers also called *faders*.

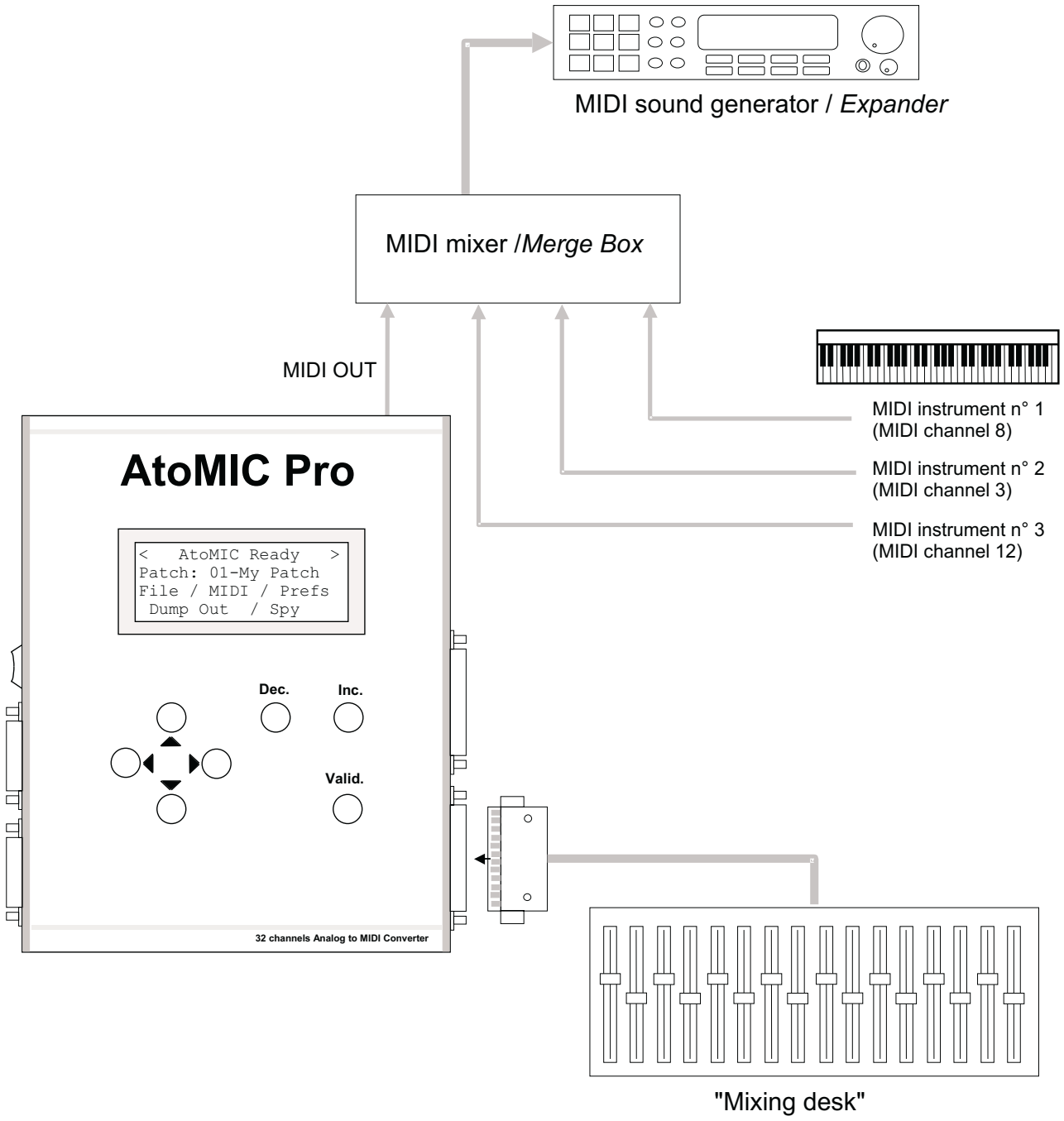
Wiring diagram



The MIDI messages produced by ***AtoMIC Pro*** can then be mixed[16] with the MIDI messages coming from one or more MIDI instruments (keyboard, wind instrument controller, etc.) set to different MIDI channels. All these messages can then be sent to a MIDI sound generator. This mixing desk thus enables the user to control the level of each MIDI instrument.

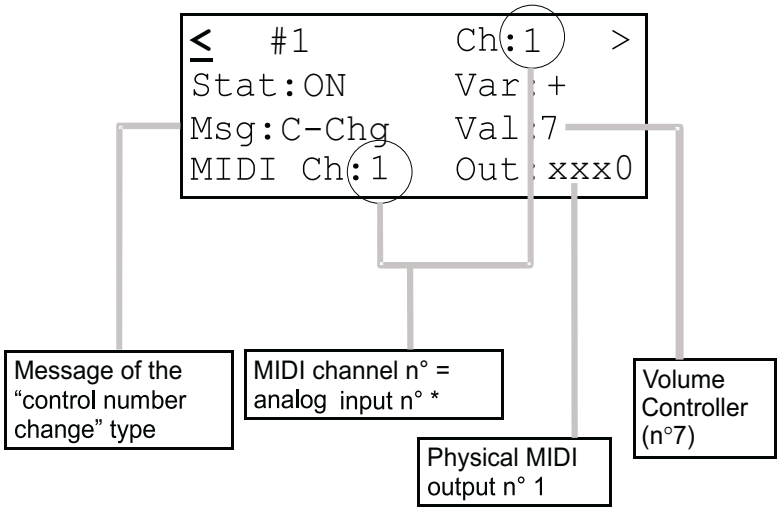
16. Using a *merge box*.

MIDI configuration example for the "mixing desk":



Configuration example of *AtoMIC Pro* for the MIDI "mixing desk"

Since the mixing desk must control the MIDI volume controllers, first set the type of MIDI message (`Msg` field in the main configuration menu) to the value `C-Chg` (*control change*). Since we want to control the volume, which is controller number 7, the `Val` field must be set to this same value. These settings must be changed for each analog input which is connected to a potentiometer. The following example shows the configuration of analog inputs 1 to 16:



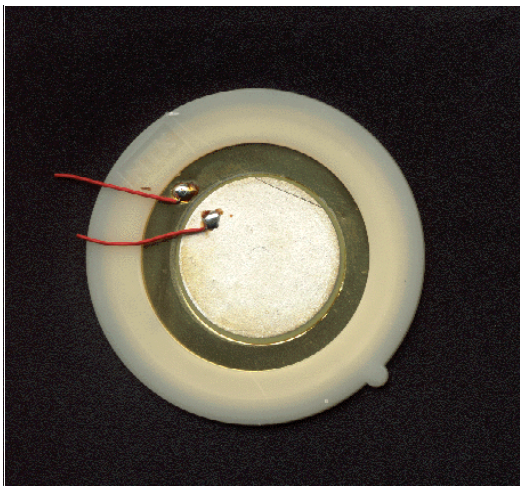
* Arbitrary decision. Each potentiometer can control any MIDI channel.

Furthermore, these potentiometers can be used to control any controller number, and also the pressure for a particular channel, polyphonic pressure, pitch change, etc.

A second set of potentiometers (wired onto the second connector of the analog inputs) could be used to control the panpots of the 16 MIDI channels (controller number 10) as well as the volume. In this case, the linear potentiometers can be replaced with rotating potentiometers, since that is the type of potentiometer used on audio mixing desks.

Using piezoelectric sensors

Piezoelectric sensors are made of a material which generates an electrical voltage when it is bent mechanically. This type of sensor usually comes in the form of a metallic disk approximately 0.5 to 1 mm thick, and of different diameters. They are generally used to detect shocks and measure their intensity. This is the case with MIDI drum kits which convert shocks into MIDI notes.



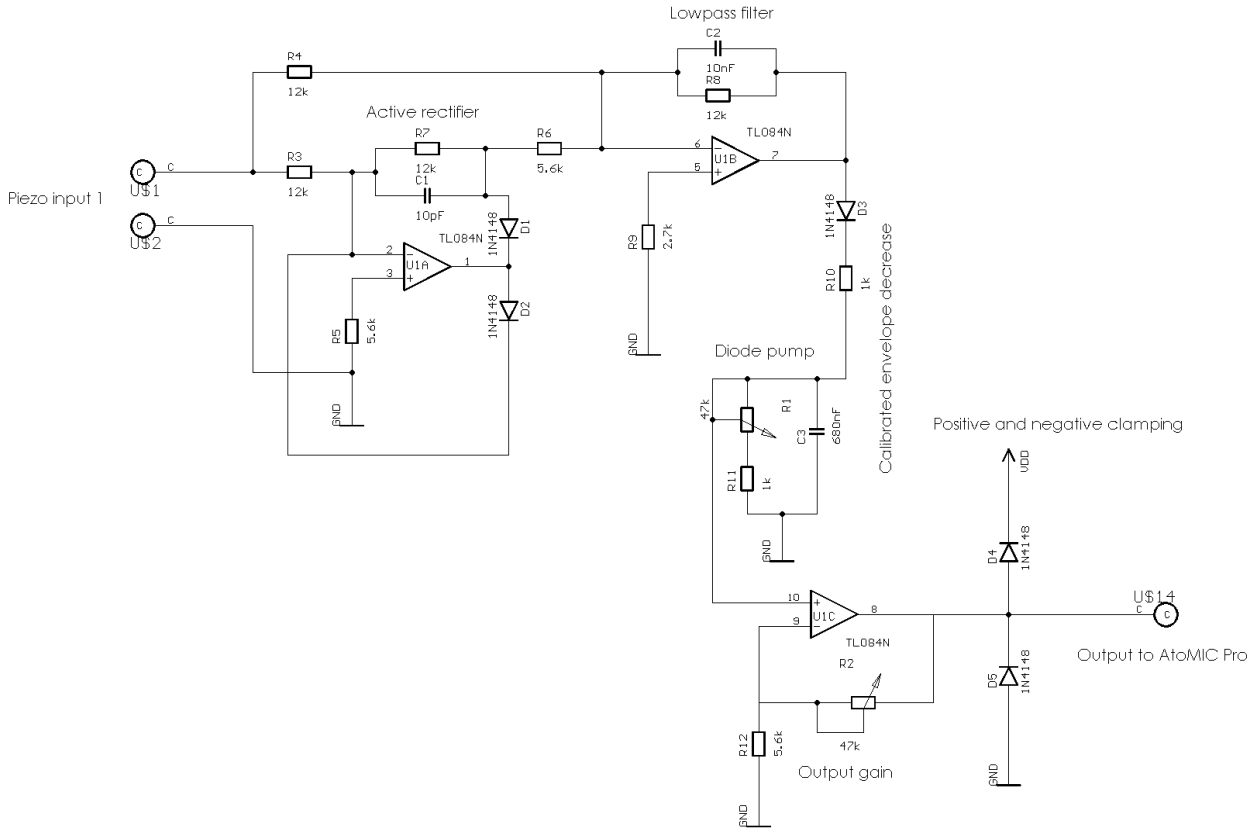
The signal from a piezoelectric sensor cannot be wired directly into the analog inputs of ***AtoMIC Pro***, and this for two reasons:

- Certain sensors with a small diameter have too small an output voltage.
- The signal is of the undulatory type and therefore incompatible with the envelope detection of ***AtoMIC Pro*** which only works for continuous signals.

A piezoelectric sensor must be connected to an electronic envelope extraction device[17] so that the signal may be used by ***AtoMIC Pro***.

17. Optional. Not supplied with ***AtoMIC Pro***, but available in the form of a separate kit.

Electronic circuit of the envelope extraction system



In the illustration above, the first part of the circuit is a signal rectifier for the piezoelectric sensor, which eliminates all negative components which could damag*e* ***AtoMIC Pro***. This signal is then filtered and put through a circuit which controls the decrease in level of the envelope. The envelope which is obtained is then amplified and sent to an analogue input of ***AtoMIC Pro***.

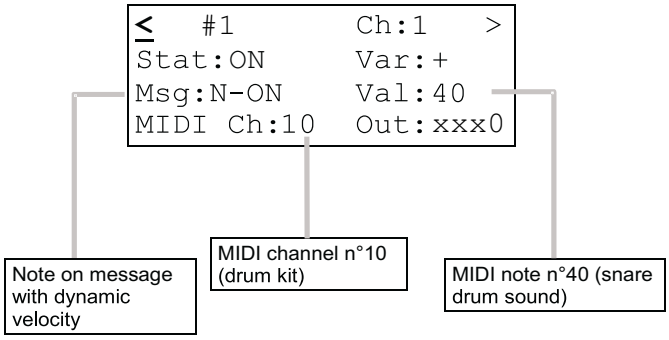
The two variable resistors R1 and R2 control two aspects of the envelope extraction:

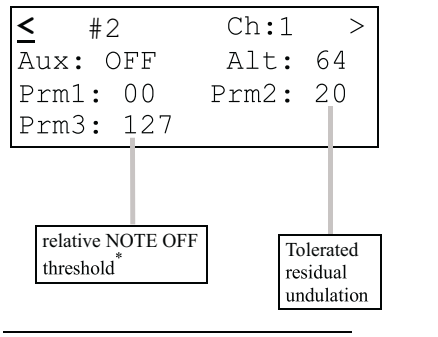
- The shape of the envelope In order to suppress the residual undulations in the decreasing phase of the signal, the parallel circuit R1-R11-C3 fixes the decrease time of the envelope. This time is adjustable from 680 µs to 32 ms, using the adjustable resistor R1.
- The output gain, to adapt the level to that of the different piezoelectric sensors already in use (R2).

These two controls must be adjusted for each sensor. There is no default setting since the amplitude and time of resonance of the sensor depends not only on its diameter, but also on the surface it is attached to.

Configuration example of *AtoMIC Pro* for a piezoelectric sensor

The signal from the envelope extraction circuit can be connected to ***AtoMIC Pro*** in order to generate MIDI notes. In this case, the configuration of ***AtoMIC Pro*** is as follows:





* Set to its maximum value to avoid triggering multiple notes.

The relative NOTE OFF threshold determines, during the decreasing phase of the envelope, when to switch the current note off, and to allow another note to be triggered. If the envelope undulates during the decrease in level, and the relative NOTE OFF threshold is too low, multiple triggering of notes may occur.

- Control this parameter to get the result you want.

To obtain valid detection of the maximum level of the envelope which will determine the velocity of the MIDI note, it is essential that the value of the tolerated residual undulation of the envelope be set (`Prm2`).

- increase the value of this parameter if the envelope stays very undulatory during its increase in level. Refer to section 2, *Interface configuration guide*, to the paragraph entitled *Choosing the MIDI message* and *Multipurpose parameters numbers 2 and 3* for more details on the different aspects of envelope detection using *AtoMIC Pro*.

→ **NOTE :**

The best way to get rid of the residual undulations of the envelope during its decrease in level is to increase the envelope length using the corresponding adjustable resistance on the conditioning module, until you get the result you want.

List of MIDI controllers

N°	*Function*	*Value*	
0	Bank Select	0-127	MSB
1	Modulation wheel	0-127	MSB
2	Breath control	0-127	MSB
3	Undefined	0-127	MSB
4	Foot controller	0-127	MSB
5	Portamento time	0-127	MSB
6	Data Entry	0-127	MSB
7	Channel Volume (formerly Main Volume)	0-127	MSB
8	Balance	0-127	MSB
9	Undefined	0-127	MSB
10	Pan	0-127	MSB
11	Expression Controller	0-127	MSB
12	Effect control 1	0-127	MSB
13	Effect control 2	0-127	MSB
14	Undefined	0-127	MSB
15	Undefined	0-127	MSB
16-19	General Purpose Controller (1-4)	0-127	MSB
20-31	Undefined	0-127	MSB
32	Bank Select	0-127	LSB
33	Modulation	0-127	LSB
34	Breath control	0-127	LSB
35	Undefined	0-127	LSB
36	Foot controller	0-127	LSB
37	Portamento time	0-127	LSB
38	Data entry	0-127	LSB
39	Channel Volume (formerly Main Volume)	0-127	LSB
40	Balance	0-127	LSB
41	Undefined	0-127	LSB
42	Pan	0-127	LSB
43	Expression Controller	0-127	LSB
44	Effect control 1	0-127	LSB
45	Effect control 2	0-127	LSB
46	Undefined	0-127	LSB
47	Undefined	0-127	LSB
48-51	General Purpose Controller (1-4)	0-127	LSB
52-63	Undefined	0-127	LSB
64	Damper pedal on/off (Sustain)	<63=off	>64=on
65	Portamento on/off	<63=off	>64=on
66	Sustenuto on/off	<63=off	>64=on
67	Soft pedal on/off	<63=off	>64=on
68	Legato Footswitch	<63=off	>64=on
69	Hold 2	<63=off	>64=on
70	Sound Controller 1 (Sound Variation)	0-127	LSB
71	Sound Controller 2 (Timbre)	0-127	LSB
72	Sound Controller 3 (Release Time)	0-127	LSB
73	Sound Controller 4 (Attack Time)	0-127	LSB
74	Sound Controller 5 (Brightness)	0-127	LSB
75	Sound Controller 6	0-127	LSB
76	Sound Controller 7	0-127	LSB
77	Sound Controller 8	0-127	LSB
78	Sound Controller 9	0-127	LSB
79	Sound Controller 10	0-127	LSB
80-83	General Purpose Controller (5-8)	0-127	LSB
84	Portamento Control	0-127	Source Note
85-90	Undefined	0-127	LSB
91	Effects 1 Depth	0-127	LSB
92	Effects 2 Depth	0-127	LSB
93	Effects 3 Depth	0-127	LSB
94	Effects 4 Depth	0-127	LSB
95	Effects 5 Depth	0-127	LSB
96	Data entry +1	N/A	
97	Data entry -1	N/A	
98	Non-Registered Parameter Number LSB	0-127	LSB
99	Non-Registered Parameter Number MSB	0-127	LSB
100	Registered Parameter Number LSB	0-127	LSB
101	Registered Parameter Number MSB	0-127	LSB
102-119	Undefined		
120-127	Mode messages		

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